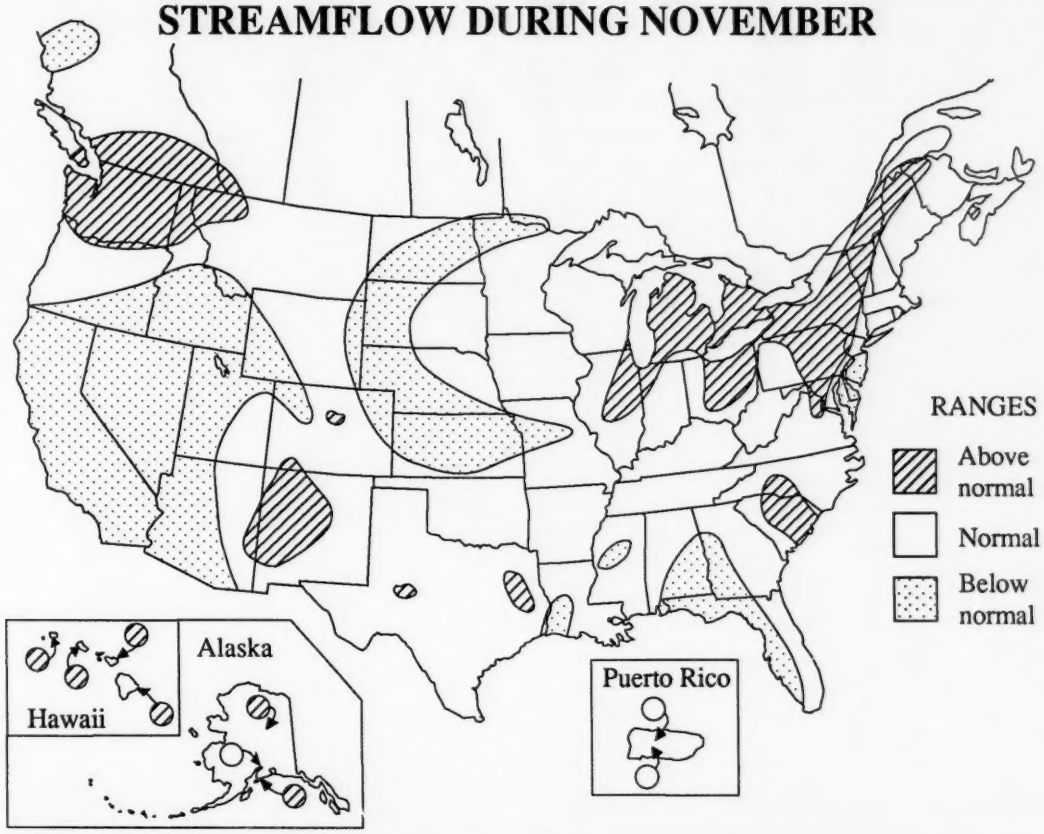
National Water Conditions

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

NOVEMBER 1990

STREAMFLOW DURING NOVEMBER



The "Pineapple Express"-- the name given by the National Weather Service (NWS) to the fall storm route from Hawaii to the Pacific Northwest--brought two storms which caused severe floods and damages November 9 and 24.

On November 20, a severe flood occurred on Kamananui Stream at Maunawai, Oahu, Hawaii. A week of steady rainfall ended with a sudden thunderstorm, which dropped over 9 inches of rain in 2 hours in the vicinity of Waimea in northern Oahu.

However, in most of California and part of Florida, there was continuing drought. According to the *California Water Supply Outlook*, "precipitation still lags far behind throughout the State, with the Sacramento basin precipitation averages about 25 percent of normal so far this water year.

Streamflow was in the normal to above-normal range at 80 percent of the index stations in southern Canada, the United States, and Puerto Rico during November. Below-normal range streamflow occurred in 23 percent of the area of the conterminous United States and southern Canada during November.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--averaged 14 percent above median and in the normal range during November, 8 percent more than during October.

Monthend index reservoir contents were in the below-average range at 35 of 100 reporting sites, compared with 40 of 100 during October, and 34 of 100 during November 1989.

Mean November elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) were in the below-normal range on Lake Superior and in the normal range on Lake Huron, Lake Erie, and Lake Ontario.

Utah's Great Salt Lake remained at 4,202.40 feet above National Geodetic Vertical Datum of 1929 as lake level paused in its seasonal decline. Lake level is 2.20 feet lower than a year ago.

SURFACE-WATER CONDITIONS DURING NOVEMBER 1990

The "Pineapple Express"— the name given by the National Weather Service (NWS) to the fall storm route from Hawaii to the Pacific Northwest—brought two storms, with heavy rains and warm temperatures, across Washington during November. Severe floods and damages (facing page) were caused by the November 9 and 24 storms.

On November 20, a severe flood occurred on Kamananui Stream at Maunawai, Oahu, Hawaii. A week of steady rainfall ended with a sudden thunderstorm, which dropped over 9 inches of rain in 2 hours in the vicinity of Waimea in northern Oahu. The last recorded gage height of 12.70 feet indicated a discharge of 10,500 cubic feet per second (cfs), with a recurrence interval of 100 years. However, peak stage (and flow) is estimated to have occurred about 90 minutes after the gage was destroyed. Therefore, the actual peak discharge was likely greater than that which was recorded. The previous peak of record, 8,540 cfs in March1980, had a recurrence interval of about 50 years.

Total rainfall for the week ending November 24 (table below) at all NWS stations in the current data network with 2 or more inches for the week show where the heaviest rains fell in the United States. Only 3 of the 16 sites are not in Washington or Hawaii.

The heaviest recorded 24-hour rain during the week ending November 24 fell at Hilo, Hawaii, Hawaii, 10.63 inches. The heaviest 24-hour rainfall recorded in Washington was 2.64 inches at Quillayute.

Station	Total
Hilo/Lyman, Hawaii, Hawaii	23.10
Stampede Pass, Washington	13.12
Kokee, Kauai, Hawaii	8.11
Olympia, Washington	6.98
Tacoma/Ft Lewis/Gray Air Force Base, Washington	6.54
Tacoma/McChord Air Force Base, Washington	6.16
Astoria, Oregon	6.10
Quillayute, Washington	5.86
Hoquiam, Washington	5.84
Lihue, Kauai, Hawaii	4.60
Whidbey Island Naval Air Station, Washington	4.02
Seattle-Tacoma, Washington	3.98
Bellingham, Washington	3.64
Kahalui, Maui, Hawaii	2.94
North Bend, Oregon	2.79
Sault Ste. Marie, Michigan	2.11

(Continued on page 5)

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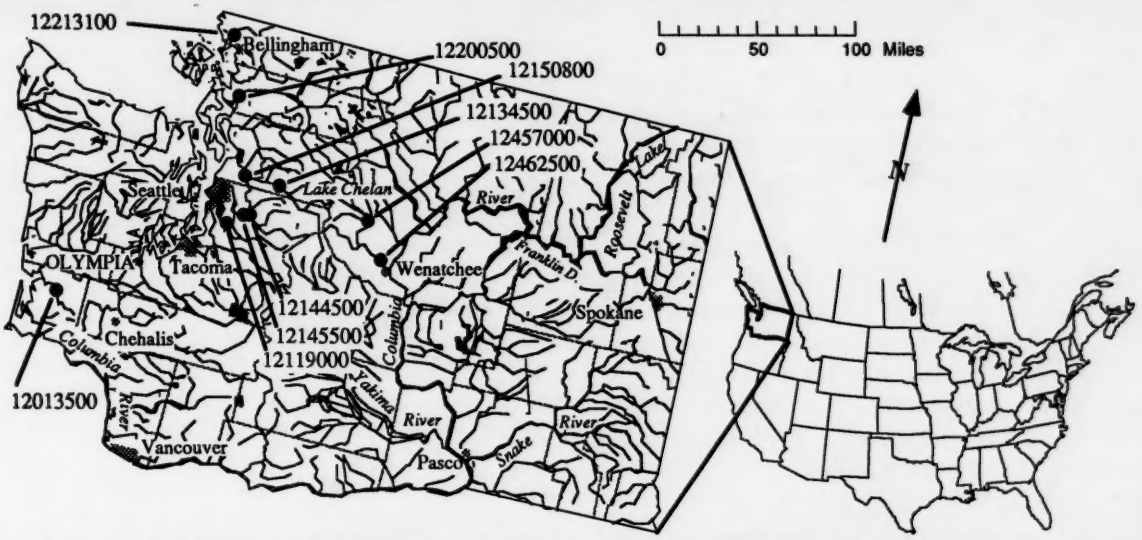
FLOODS OF NOVEMBER 1990 IN WASHINGTON



On November 9, a major tropical storm moved into the northwestern part of Washington. U.S. Geological Survey snow pillows indicated water equivalents of about 5 inches at Cayuse Pass in the Cowlitz River basin and 9 inches at Marten Pass near Mt. Baker before the storm. Flooding occurred in lowland areas of basins to the north and west of Tacoma. Upland rivers began peaking on November 10, but lowland mainstem rivers peaked 1-3 days later. Only the Nooksack River at Ferndale had a record peak discharge, recurrence interval 100 years, and the only other station with a peak discharge exceeding that of the 25-year flood was the Skagit River near Mt. Vernon (see table below), where the peak did not exceed that of record. Damages were estimated at $40 million. Similar, but less severe floods occurred in November and December 1989.

On November 24, after more snow had fallen, the "Pineapple Express"—the name given by the National Weather Service (NWS) to the fall storm route from Hawaii to the Pacific Northwest—brought a second intense storm, with heavy rains and warm temperatures, across Washington. Record rainfall and snowmelt caused by high temperatures (the warm storms caused the freeze level to retreat to above 9,000 feet) produced high water on both sides of the Cascade Range. More than 2,000 people were evacuated and at least one person was killed. The storms caused extremely high winds in eastern Washington. The NWS reported wind gusts as high as 56 miles per hour (mph) in Spokane. Unofficial estimates reported wind gusts of 90 mph in the Pasco area. The NWS reported an all-time-record 24-hour rainfall of 5.82 inches in Olympia and a November 24-hour record of 3.56 inches at the Seattle-Tacoma International Airport.

Peak discharges during the second flood exceeded those of record at eight stations (see table below), with recurrence intervals at those sites ranging from 25 years to over 100 years. Peak discharge of the Skagit River near Mt. Vernon again was less than that of 1906, but the recurrence interval for the November 25 peak was 100 years, compared with 50 years for the November 11 peak.

Although final damage estimates are not yet available, damages will be far in excess of those for the flood of November 9-10. Repair of the old and new I-90 floating bridges across Lake Washington in Seattle, damaged in the November 24-26 flood, is likely to exceed $50 million. The new structure was damaged when a section of the old floating bridge sank, severing at least 12 of the cables that secured the new structure to the lake bottom. Highways, dikes, and levees also were severely damaged by the double storm sequence. A total of 17 counties were declared State disaster areas.

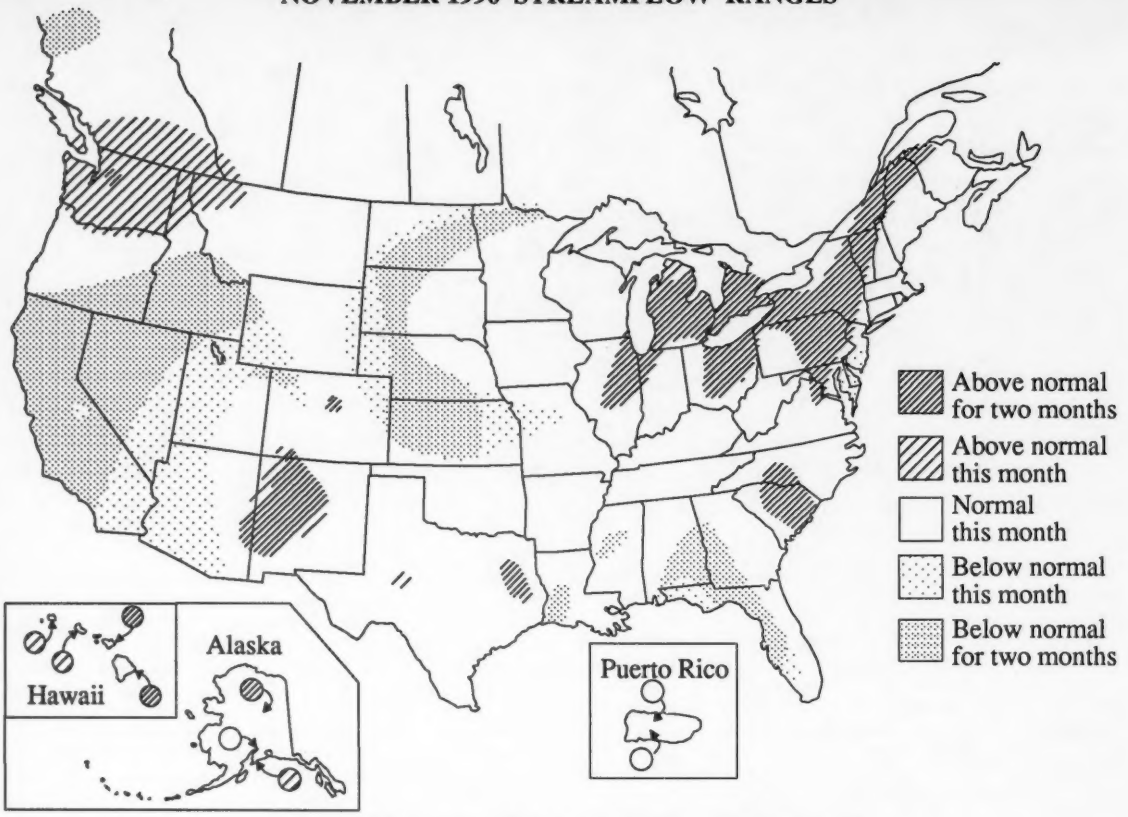
Provisional data; subject to revision

FLOOD DATA FOR SELECTED SITES IN WASHINGTON, NOVEMBER 1990

WRD Station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
								Discharge			Recurrence interval (years)
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Cfs	Cfs per square mile	
	WILLAPA RIVER BASIN										
12013500	Willapa River near Willapa	130	1948-	Jan. 9, 1990	24.06	11,700	Nov. 24	24.21	11,800	91	25
	WASHINGTON LAKE BASIN										
12119000	Cedar River at Renton	184	1945-	Dec. 4, 1975	14.14	8,800	25	[1]16.4	[1]8,800	48	[2]100
	SNOHOMISH RIVER BASIN										
12134500	Skykomish River near Gold Bar	535	1928-	Dec. 26, 1980	21.38	90,400	24	22.49	101,600	190	50
12144500	Snoqualmie River near Snoqualmie	375	1958-	Nov. 23, 1959	19.78	61,000	24	21.1	74,300	198	100
12145500	Raging River near Fall City	30.6	1945-	Nov. 23, 1986	6.27	5,330	24	6.34	5,540	181	100
12150800	Snohomish River near Monroe	1,537	1963-	Dec. 4, 1975	22.92	115,000	25	25.42	135,500	88	[3]1.20
	SKAGIT RIVER BASIN										
12200500	Skagit River near Mt. Vernon	3,093	1940-	1906	37	180,000	11	[1]36.6	[1]142,000	46	[2]50
							25	[1]37.4	[1]155,000	50	[2]100
	NOOKSACK RIVER BASIN										
12213100	Nooksack River at Ferndale	786	1966-	Dec. 3, 1975	21.97	52,700	11	[4]23.59	[1,4]55,000	70	100
	WENATCHEE RIVER BASIN										
12457000	Wenatchee River at Plain	591	1910-79 1989	May 29, 1948	12.48	22,700	25	14.27	31,900	54	[3]1.39
12462500	Wenatchee River at Monitor	1,301	1962-	Dec. 27, 1980	27.23	29,600	25	29.79	43,000	33	[3]1.18

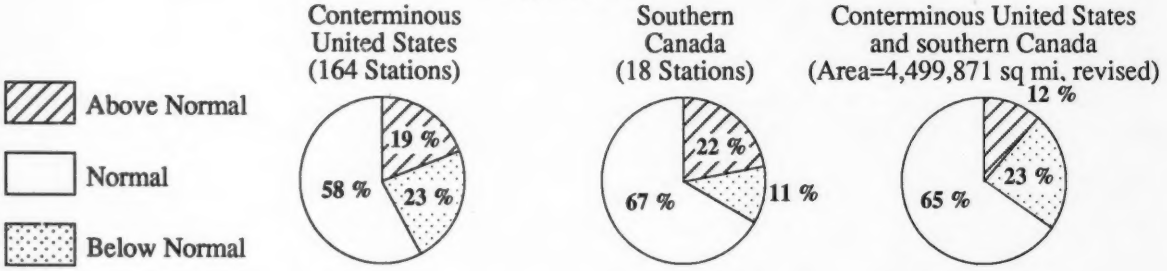
[1] Estimated.
[2] Regulated.
[3] Recurrence interval greater than 100 years. Value shown is approximate ratio of discharge to that of 100-year flood.
[4] Tidal backwater effect.

NOVEMBER 1990 STREAMFLOW RANGES

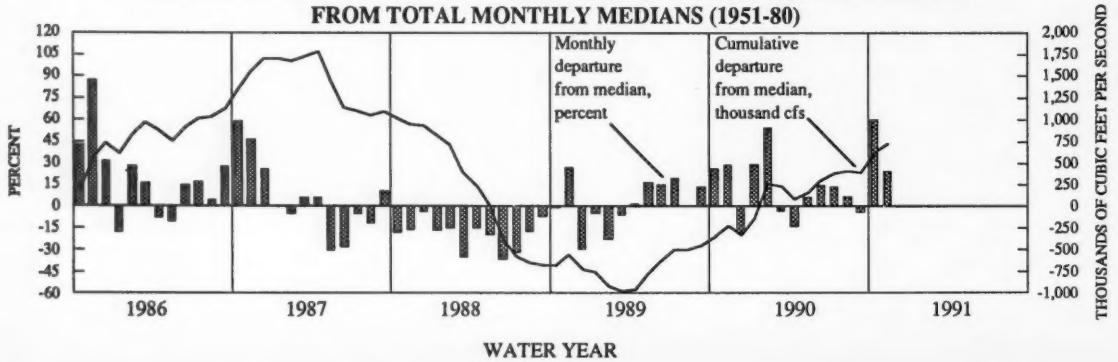


SUMMARY OF NOVEMBER 1990 STREAMFLOW

FLOW RANGES



MONTHLY AND CUMULATIVE DEPARTURE OF TOTAL MONTHLY MEANS FROM TOTAL MONTHLY MEDIANS (1951-80)



However, in most of California and part of Florida, there was continuing drought. According to the ***California Water Supply Outlook*** (California Department of Water Resources, Division of Flood Management, Flood Operations and Hydrology Branches) of November 29, "precipitation still lags far behind throughout California. In the Sacramento basin precipitation averages about 25 percent of normal so far this water year. Streamflows throughout the State are still very low. On the Sacramento River at Colusa the stage is over 20 feet below the sill of Colusa Weir, which overflowed during November in 1981, 1982, 1983, and 1984. Fremont Weir also overflowed during November in 1981 and 1983. Over the last three weeks, storage in the reservoirs of the Central Valley system have dropped about 50,000 acre-feet during a time when reservoirs are usually beginning to recover from the previous irrigation season. Reservoir storage in the Central Valley system is presently only 51 percent of normal compared to 75 percent of normal last year at this time." (See also pages 6-7.) Northwestern Florida continues to have record or near-record low streamflow, lake, and ground-water levels. (See pages 5, 7, and 16-19.)

Streamflow was in the normal to above-normal range at 80 percent of the index stations in southern Canada, the United States, and Puerto Rico during November, compared with 83 percent of stations in those ranges during October, and 79 percent of stations in those ranges during November 1989. Below-normal range streamflow occurred in 23 percent of the area of the conterminous United States and southern Canada during November 1990, compared with 20 percent during October and 11 percent during November 1989. The bar graph showing total mean and median monthly streamflow for all stations in the conterminous United States and southern Canada has been replaced by a combination bar/line graph (see bottom of page 4) showing the monthly percent departure of total monthly mean from total monthly median flow, and the cumulative departure from median in cfs. The cumulation begins with October 1985. Eight stations were excluded from the data set used to generate the old graph. (The data set for this graph is all of the stations used to show data for the 12 hydrologic areas for which graphs appear on pages 14-15.) Those eight stations are marked with a * in the *Large river table* (page 9) as noted in the *Explanation of data* (page 23). Total November 1990 flow of 554,200 cfs for the 174 index stations in the conterminous United States and southern Canada was 24 percent above median, 8 percent less than last month, and 4 percent less than flow during November 1989.

Six new extremes (table on page 6), two lows and four highs, occurred at streamflow index stations during November compared with one low and four highs during October. Hydrographs for those stations where new extremes occurred are on page 7, including an expanded view of part of the hydrograph for Arroyo Seco.

The combined flow of the 3 largest rivers in the lower 48 States—Mississippi, St. Lawrence, and Columbia—averaged 763,200 cfs (14 percent above median and in the normal range) during November, 8 percent more than during October. Flow of the St. Lawrence River was in the normal range for the ninth consecutive month. Flow of the Mississippi River was in the normal range for the second month (after five consecutive months in the above-normal range), and flow of the Columbia River was in the above-normal range after a normal October and a below-normal September. Hydrographs for both the combined and individual flows of the "Big 3" are on page 8. Dissolved solids and water temperatures at five large river stations are also given on page 8. Flow data for the "Big 3" and 42 other large rivers are given in the Flow of Large Rivers table on page 9.

Monthend index reservoir contents for November 1990 were in the below-average range (below the monthend average for the period of record by more than 5 percent of normal maximum contents) at 35 of 100 reporting sites, compared with 40 of 100 during October 1990, and 34 of 100 during November 1989, including most reservoirs in Nebraska, the Dakotas, Wyoming, Colorado, Idaho, Utah, Nevada, and California. Contents were in the above-average range at 40 reservoirs (compared with 45 last month), including most reservoirs in Maine, Vermont, Massachusetts, New York, New Jersey, Pennsylvania, Maryland, South Carolina, the Tennessee Valley, Georgia, Alabama, Texas, Wisconsin, and Washington. Reservoirs with contents in the below-average range and significantly lower than last year (with normal maximum contents of at least 1,000,000 acre-feet) are: Lake Sidney Lanier, Georgia; the Little Tennessee Projects, Tennessee Valley; Lake McConaughy, Nebraska; Upper Snake River, Idaho-Wyoming; Bear Lake, Idaho-Utah; Folsom, Clair Engle Lake, Lake Berryessa, and Shasta Lake, California; and also the Colorado River Storage Project. Reservoirs

(Continued on page 6)

with less than 10 percent of normal maximum contents (November average in parentheses) are: John Martin, Colorado, 7 percent (16); Isabella, 8 percent (24), and Pine Flat, 3 percent (39), California; Lake Tahoe, California-Nevada, 0 percent (46); Rye Patch, Nevada, 0 percent (50); and San Carlos, Arizona, 5 percent (21). Graphs of contents for seven reservoirs are shown on page 10 with contents for the 100 reporting reservoirs given on page 11.

Mean November elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) were in the below-normal range on Lake Superior and in the normal range on Lake Huron, Lake Erie, and Lake Ontario. Levels on all four lakes have been in the same ranges for six months. Levels fell from those for October on all four lakes. November levels ranged from 0.27 foot (Lake Erie) to 0.05 foot (Lake Superior) lower than those for October. Monthly means have now been in the below-normal range for 14 months on Lake Superior. Monthly means have been in the normal range for 6 months on Lake Huron, for 32 months on Lake Erie and for 19 months on Lake Ontario. November 1990 levels ranged from 0.11 foot lower (Lake Ontario) to 0.53 foot higher (Lake Erie) than those for November 1989. Stage hydrographs for the master gages on Lake Superior, Lake Huron, Lake Erie, and Lake Ontario are on page 12.

Utah's Great Salt Lake (graph on page 12) remained at 4,202.40 feet above National Geodetic Vertical Datum (NGVD) of 1929 during November as lake level paused in its seasonal decline after peaking at 4,204.70 feet above NGVD of 1929 in March-April. Lake level is 2.20 feet lower than at the end of November 1989, and 9.45 feet lower than the maximum of record which occurred in June 1986 and March-April 1987.

Streamflow conditions during November 1990 and November 1989 are shown by maps on page 13. November 1990 has about 120 percent more area in the below-normal range, 33 percent less area in the above-normal range, and about 10 percent less area in the normal range than November 1989. Parts of southeastern Canada and the eastern United States, as well as part of the Pacific Northwest, have streamflow in the above-normal range during both months. A few areas in the West, Midwest, Georgia, and Florida have streamflow in the below-normal range during both months. The locations of reservoirs with below-average contents at the end of November 1990 and November 1989 are also shown on the respective maps.

Graphs for12 hydrologic areas show monthly percent departure of streamflow from median for the 1986-90 water years (page 14) and also compare monthly streamflow for the 1990 and 1991 water years with median monthly streamflow for 1951-80 (page 15). Streamflow was below median in the Hudson Bay basin, Florida and Gulf of Mexico basins, Southern Great Plains and Rio Grande basins, Colorado River basin, and also in the Great and Other Closed basins areas. Large increases in streamflow occurred in the Pacific Slope and Columbia River basins, but were generally confined to the northern part of the Pacific Slope basin and the western part of the Columbia River basin.

Provisional data; subject to revision

NEW EXTREMES DURING NOVEMBER 1990 AT STREAMFLOW INDEX STATIONS

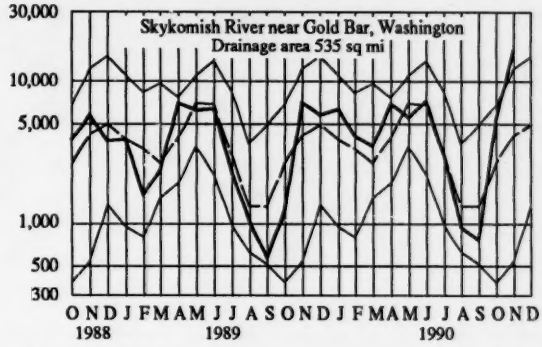
Station number	Stream and place of determination	Drainage area (square miles)	Previous November extremes (period of record) Years of record	Monthly mean in cfs (year)	Daily mean in cfs (year)	November 1990 Monthly mean in cfs	Percent of median	Daily mean in cfs	Day
			LOW FLOWS						
02320500	Suwannee River at Branford, Florida	7,880	59	1,701 (1943)	1,640 (1968)	1,674	50	1,630	15
11098000	Arroyo Seco near Pasadena, California	16.0	79	.06 (1933)	0 (1926)	.02	2	0	*
			HIGH FLOWS						
12134500	Skykomish River near Gold Bar, Washington	535	62	11,930 (1932)	51,600 (1932)	16,093	386	88,400	24
16068000	East Branch of North Fork Wailua River near Lihue, Kauai, Hawaii	6.27	75	187 (1965)	1,280 (1968)	226	430	1,410	18
16587000	Honopou Stream near Huelo, Maui, Hawaii	.64	79	16.5 (1921)	184 (1924)	21.9	533	224	19
16700000	Waiakea Stream near Mountain View, Hawaii, Hawaii	17.4	60	30.6 (1972)	99.0 (1951)	33.1	212	75.0	18

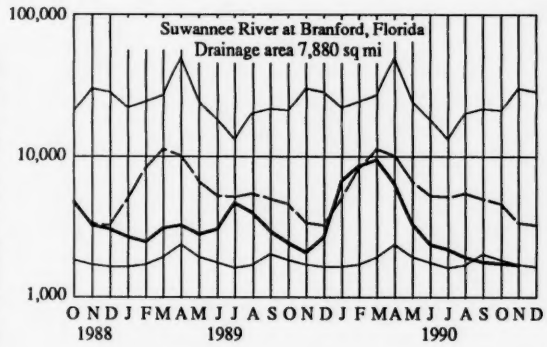
* Occurred more than once.

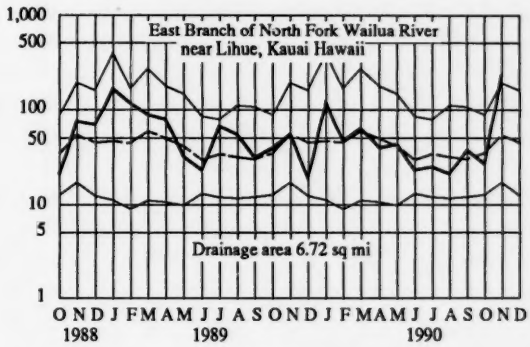
MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

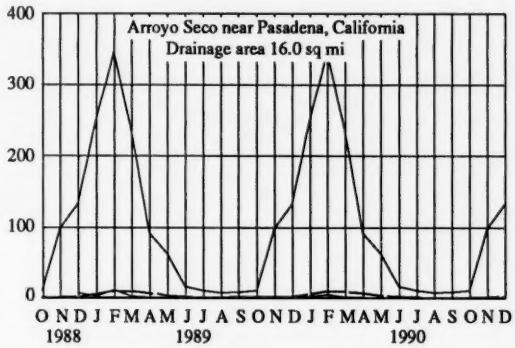
Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.

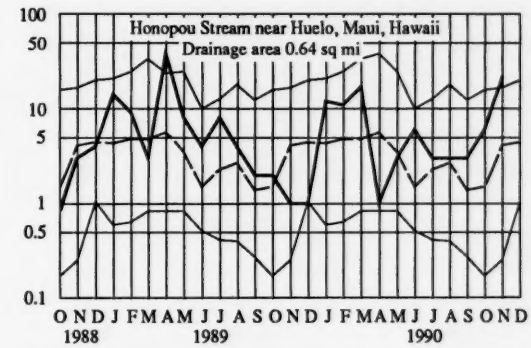
DISCHARGE IN CUBIC FEET PER SECOND

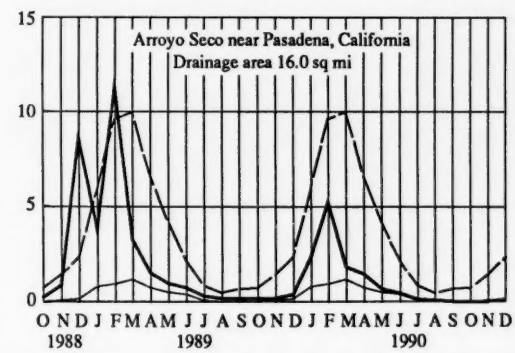


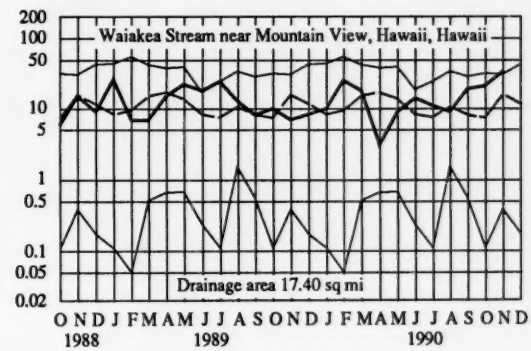

Suwannee River at Branford, Florida
Drainage area 7,880 sq mi
100,000
10,000
1,000
O N D J F M A M J J A S O N D J F M A M J J A S O N D
1988
1989
1990




Arroyo Seco near Pasadena, California
Drainage area 16.0 sq mi
400
300
200
100
0
O N D J F M A M J J A S O N D J F M A M J J A S O N D
1988
1989
1990

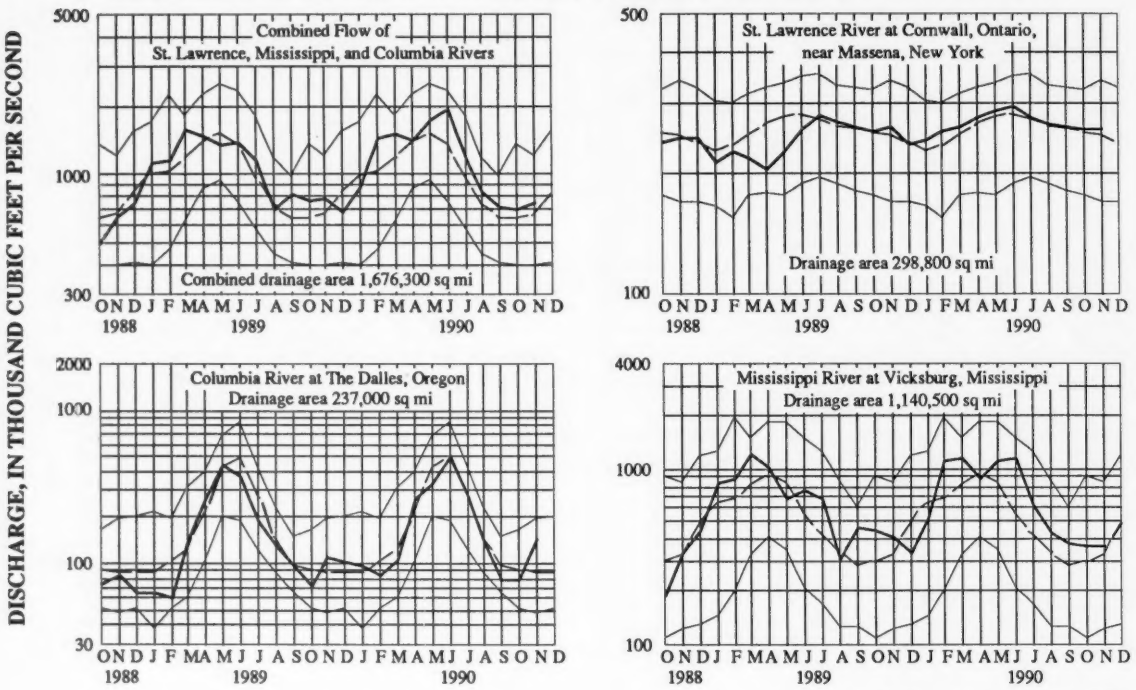






HYDROGRAPHS FOR THE "BIG THREE" RIVERS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.


DISCHARGE, IN THOUSAND CUBIC FEET PER SECOND
Combined Flow of St. Lawrence, Mississippi, and Columbia Rivers
Combined drainage area 1,676,300 sq mi
St. Lawrence River at Cornwall, Ontario, near Massena, New York
Drainage area 298,800 sq mi
Columbia River at The Dalles, Oregon
Drainage area 237,000 sq mi
Mississippi River at Vicksburg, Mississippi
Drainage area 1,140,500 sq mi
O N D J F M A M J J A S O N D J F M A M J J A S O N D
1988
1989
1990

Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES, FOR NOVEMBER 1990, AT DOWNSTREAM SITES ON FIVE LARGE RIVERS

Station number	Station name	November data of following calendar years	Stream discharge during month	Dissolved-solids concentration[1]		Dissolved-solids discharge[1]			Water temperature[2]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean	Minimum	Maximum	Mean in °C	Minimum in °C	Maximum in °C
						(tons per day)					
01463500	Delaware River at Trenton, New Jersey, (Morrisville, Pennsylvania)	1990	14,420	64	100	3,153	1,816	10,030	8.5	6.0	12.5
		1944-89 (Extreme yr)	10,130 (1955)	55 (1964)	151	[3]2,819	469 (1963)	12,300 (1972)	[3]8.5	2.0	19.0
			[4]9,825								
07289000	Mississippi River at Vicksburg, Mississippi	1990	362,400	240	263	243,700	205,800	306,400	14.5	13.5	16.0
		1975-89 (Extreme yr)	457,100 (1984)	181	330 (1988)	297,400	123,000 (1976)	677,800 (1985)	13.5	8.0	20.0
			[4]320,600								
03612500	Ohio River at lock and dam 53, near Grand Chain, Illinois, (streamflow station at Metropolis, Illinois)	1990	176,700	214	280	.....	81,500	147,000	...	14.0	18.0
		1954-89 (Extreme yr)	186,200 (1957)	129	425 (1968)	.....	13,900 (1986)	406,000 (1957)	...	1.0	19.5
			[4]147,600								
06934500	Missouri River at Hermann, Missouri. (60 miles west of St. Louis, Missouri)	1990	29,500	466	496	37,900	29,900	53,200	13.0	10.5	16.0
		1975-89 (Extreme yr)	83,790 (1985)	204	516 (1987)	88,200	30,600 (1989)	246,000 (1985)	9.5	3.5	15.0
			[4]54,680								
14128910	Columbia River at Warrendale, Oregon (streamflow station at The Dalles, Oregon)	1990	148,000	90	94	37,400	27,600	60,100	12.0	10.5	13.5
		1975-89 (Extreme yr)	132,000 (1980)	38	128 (1978)	36,700	10,800 (1980)	66,400 (1978)	11.5	3.0	15.0
			[4]87,960								

[1]Dissolved -solids concentrations, when not analyzed directly, are calculated on basis of measurements of specific conductance.
[2]To convert °C to °F: [(1.8 x °C) + 32] = °F.
[3]Mean for 6-year period (1983-89).
[4]Median of monthly values for 30-year reference period, water years 1951-80, for comparison with data for current month.

Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING NOVEMBER 1990

Station number	Stream and place of determination	Drainage area (square miles)	Average discharge through September 1985 (cubic feet per second)	November 1990					
				Monthly mean discharge (cubic feet per second)	Percent of median monthly discharge 1951–80	Change in discharge from previous month (percent)	Discharge near end of month		
							Cubic feet per second	Million gallons per day	Date
01014000	St. John River below Fish River at Fort Kent, Maine	5,665	9,758	12,950	183	–35	19,600	12,700	30
01318500	Hudson River at Hadley, New York	1,664	2,908	5,210	217	–24	3,950	2,550	30
01357500	Mohawk River at Cohoes, New York	3,456	5,683	9,300	187	53	6,000	3,900	30
01463500	Delaware River at Trenton, New Jersey	6,780	11,670	14,420	147	47	8,080	5,220	30
01570500	Susquehanna River at Harrisburg, Pennsylvania	24,100	34,340	44,720	181	–34	30,100	19,400	28
01646500	Potomac River near Washington, District of Columbia	11,560	[1]11,500	7,950	179	–56	5,180	3,350	30
02105500	Cape Fear River at William O. Huske Lock, near Tarheel, North Carolina.	4,852	5,002	2,158	111	–61	.....	.....	...
02131000	Pee Dee River at Peedee, South Carolina	8,830	9,871	15,870	350	–28	9,710	6,280	30
02226000	Altamaha River at Doctortown, Georgia	13,600	13,730	6,708	134	2	4,020	2,600	30
02320500	Suwannee River at Branford, Florida	7,880	6,986	1,674	50	–2	1,640	1,060	30
02358000	Apalachicola River at Chattahoochee, Florida	17,200	22,420	8,490	76	8	5,760	3,720	30
02467000	Tombigbee River at Demopolis lock and dam, near Coatopa, Alabama.	15,385	23,520	3,128	50	124	5,750	3,720	30
02489500	Pearl River near Bogalusa, Louisiana	6,573	9,880	2,542	99	9	3,610	2,330	30
03049500	Allegheny River at Natrona, Pennsylvania	11,410	[1]19,580	21,930	160	–41	27,000	17,500	26
03085000	Monongahela River at Braddock, Pennsylvania	7,337	[1]12,480	7,601	98	–39	7,060	4,560	26
03193000	Kanawha River at Kanawha Falls, West Virginia	8,367	12,550	8,266	105	–48	5,370	3,470	28
03234500	Scioto River at Higby, Ohio	5,131	4,583	3,026	186	–52	3,110	2,010	30
03294500	Ohio River at Louisville, Kentucky[2]*	91,170	115,800	107,000	171	–30	109,000	70,400	30
03377500	Wabash River at Mount Carmel, Illinois	28,635	27,660	20,040	181	–29	47,400	30,600	30
03469000	French Broad River below Douglas Dam, Tennessee[3]*	4,543	[1]6,739	3,460	74	–39	.....	.....	...
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wisconsin.[2]	6,010	4,238	3,723	106	0	4,180	2,700	30
04264331	St. Lawrence River at Cornwall, Ontario, near Massena, New York.[4]*	298,800	243,900	258,000	104	0	260,000	168,000	30
02NG001	St. Maurice River at Grand Mere, Quebec	16,300	24,910	21,700	120	–33	28,100	18,200	30
05082500	Red River of the North at Grand Forks, North Dakota	30,100	2,593	316	25	–10	296	191	30
05133500	Rainy River at Manitou Rapids, Minnesota	19,400	12,920	4,500	46	–15	4,400	2,840	27
05330000	Minnesota River near Jordan, Minnesota	16,200	3,680	723	80	–5	600	390	30
05331000	Mississippi River at St. Paul, Minnesota*	36,800	[1]11,020	6,155	98	6	4,880	3,150	30
05365500	Chippewa River at Chippewa Falls, Wisconsin	5,650	5,149	3,985	103	–42	3,300	2,130	30
05407000	Wisconsin River at Muscoda, Wisconsin	10,400	8,710	7,366	112	–18	7,500	4,850	30
05446500	Rock River near Joslin, Illinois	9,549	6,080	5,020	132	26	7,240	4,680	30
05474500	Mississippi River at Keokuk, Iowa*	119,000	63,790	44,400	97	–1	49,500	32,000	30
06214500	Yellowstone River at Billings, Montana	11,795	7,056	3,320	86	–6	2,710	1,750	30
06934500	Missouri River at Hermann, Missouri*	524,200	80,880	29,500	54	–36	35,100	22,700	30
07289000	Mississippi River at Vicksburg, Mississippi[5]*	1,140,500	584,000	362,400	113	–2	335,000	216,000	26
07331000	Washita River near Dickson, Oklahoma	7,202	1,402	907	230	37	438	283	26
08276500	Rio Grande below Taos Junction Bridge, near Taos, New Mexico.	9,730	742	586	140	32	565	365	30
09315000	Green River at Green River, Utah	44,850	6,391	2,066	74	1	.....	.....	...
11425500	Sacramento River at Verona, California	21,251	19,430	7,593	58	5	.....	.....	...
13269000	Snake River at Weiser, Idaho	69,200	18,520	11,700	78	–2	11,400	7,370	30
13317000	Salmon River at White Bird, Idaho	13,550	11,390	4,150	80	8	3,690	2,380	30
13342500	Clearwater River at Spalding, Idaho	9,570	15,510	10,200	202	132	11,200	7,240	30
14105700	Columbia River at The Dalles, Oregon[6]*	237,000	[1]193,500	142,800	162	82	202,000	131,000	30
14191000	Willamette River at Salem, Oregon	7,280	[1]23,690	28,040	105	330	46,600	30,100	30
15515500	Tanana River at Nenana, Alaska	25,600	23,810	10,330	124	–52	9,000	5,800	30
08MF005	Fraser River at Hope, British Columbia	83,800	96,250	70,620	121	32	54,000	34,900	30

[1]Adjusted.

*Indicates stations excluded from the combination bar/line graph. See Explanation of Data.

[2]Records furnished by Corps of Engineers.

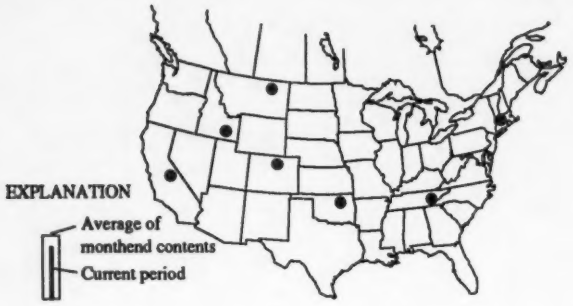
[3]Records furnished by Tennessee Valley Authority.

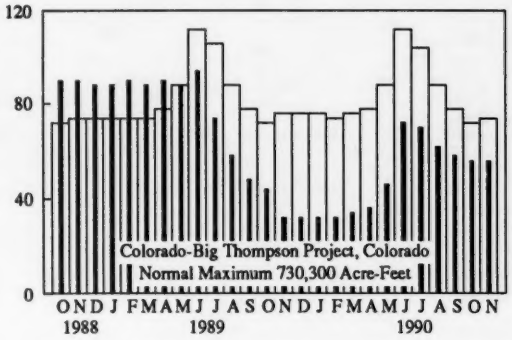
[4]Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y., when adjusted for storage in Lake St. Lawrence.

[5]Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

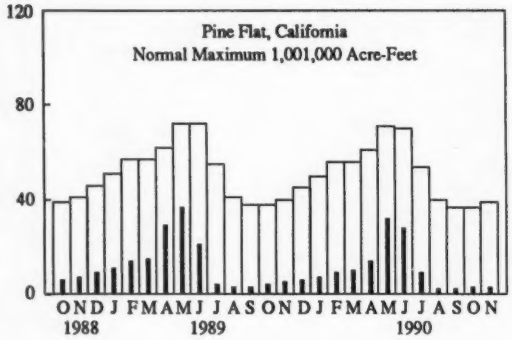
[6]Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

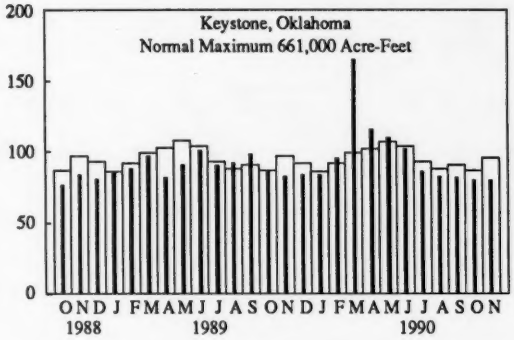
USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS

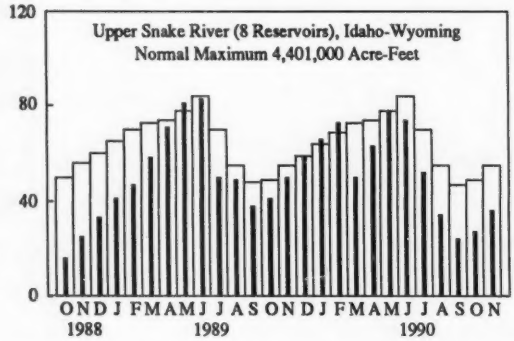


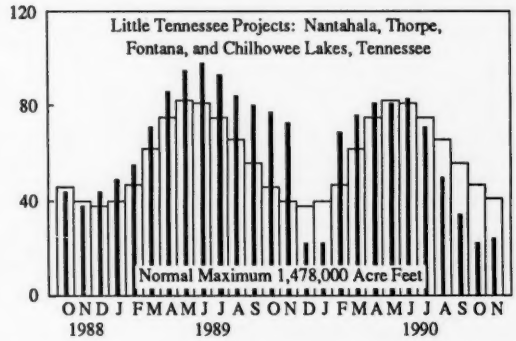

Colorado-Big Thompson Project, Colorado
Normal Maximum 730,300 Acre-Feet
120
80
40
0
O N D J F M A M J J A S O N D J F M A M J J A S O N
1988
1989
1990

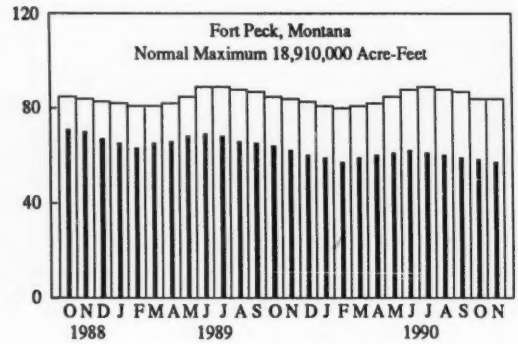
PERCENT OF NORMAL MAXIMUM

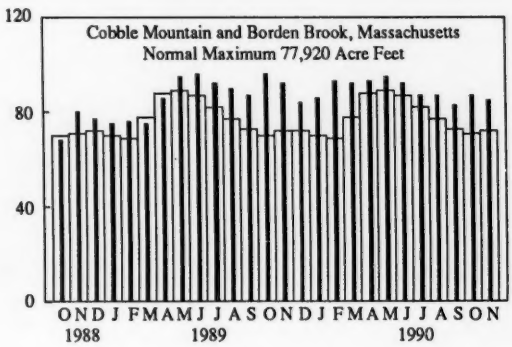





Upper Snake River (8 Reservoirs), Idaho-Wyoming
Normal Maximum 4,401,000 Acre-Feet
120
80
40
0
O N D J F M A M J J A S O N D J F M A M J J A S O N
1988
1989
1990


Little Tennessee Projects: Nantahala, Thorpe,
Fontana, and Chilhowee Lakes, Tennessee
Normal Maximum 1,478,000 Acre Feet
120
80
40
0
O N D J F M A M J J A S O N D J F M A M J J A S O N
1988
1989
1990




Cobble Mountain and Borden Brook, Massachusetts
Normal Maximum 77,920 Acre Feet
120
80
40
0
O N D J F M A M J J A S O N D J F M A M J J A S O N
1988
1989
1990

Provisional data; subject to revision

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF NOVEMBER 1990

[Contents are expressed in percent of reservoir (system) capacity. The usable storage capacity of each reservoir (system) is shown in the column headed "Normal maximum"]

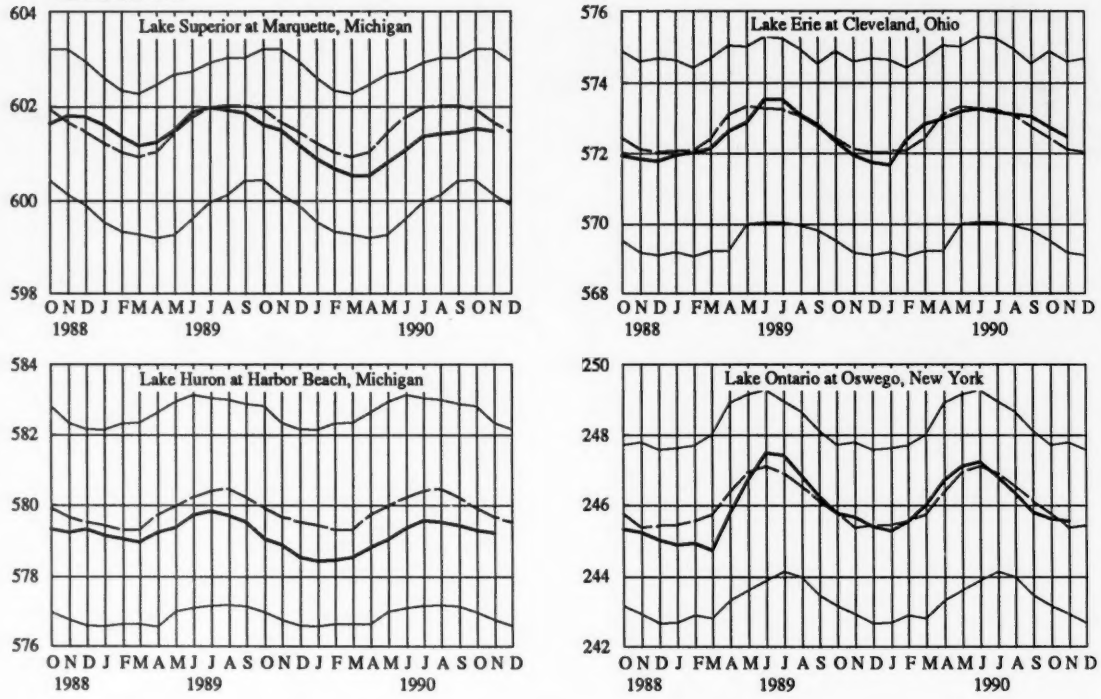
Reservoir Principal uses: F-Flood control I-Irrigation M-Municipal P-Power R-Recreation W-Industrial	Percent of normal maximum End of November 1990	End of November 1989	Average for end of November	End of October 1990	Normal maximum (acre-feet)[1]
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	42	47	40	48	[2]226,300
QUEBEC					
Allard (P)	52	87	62	75	280,600
Gouin (P)	81	58	69	68	6,954,000
MAINE					
Seven Reservoir Systems (MP)	82	62	56	82	4,107,000
NEW HAMPSHIRE					
First Connecticut Lake (P)	78	77	73	84	76,450
Lake Francis (FPR)	67	84	78	95	99,310
Lake Winnipesaukee (PR)	83	80	60	85	165,700
VERMONT					
Harriman (P)	68	82	65	75	116,200
Somerset (P)	77	87	71	78	57,390
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	85	92	72	87	77,920
NEW YORK					
Great Sacandaga Lake (FPR)	76	80	57	77	786,700
Indian Lake (FMP)	81	70	60	94	103,300
New York City Reservoir System (MW)	85	89	71	78	1,680,000
NEW JERSEY					
Wanaque (M)	74	104	66	65	85,100
PENNSYLVANIA					
Allegheny (FPR)	36	35	34	48	1,180,000
Pymatuning (FMR)	88	94	81	99	188,000
Raystown Lake (FR)	67	67	56	69	761,900
Lake Wallenpaupack (PR)	74	59	52	65	157,800
MARYLAND					
Baltimore Municipal System (M)	93	91	82	93	261,900
NORTH CAROLINA					
Bridgewater (Lake James) (P)	91	92	78	98	288,800
Narrows (Badin Lake) (P)	95	95	91	98	128,900
High Rock Lake (P)	55	82	55	99	234,800
SOUTH CAROLINA					
Lake Murray (P)	61	87	62	61	1,614,000
Lakes Marion and Moultrie (P)	76	81	65	84	1,862,000
SOUTH CAROLINA-GEORGIA					
Strom Thurmond Lake (FP)	58	76	50	64	1,730,000
GEORGIA					
Burton (PR)	95	94	61	97	104,000
Sinclair (MPR)	87	65	74	86	214,000
Lake Sidney Lanier (FMPR)	41	63	49	44	1,686,000
ALABAMA					
Lake Martin (P)	87	77	62	82	1,375,000
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	38	49	31	45	2,293,000
Douglas Lake (FPR)	21	34	18	39	1,395,000
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	51	62	43	60	1,012,000
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	46	54	36	51	2,880,000
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	24	73	41	22	1,478,000
WISCONSIN					
Chippewa and Flambeau (PR)	88	74	76	96	365,000
Wisconsin River (21 Reservoirs) (PR)	85	39	66	92	399,000
MINNESOTA					
Mississippi River Headwater System (FMR)	27	31	27	31	1,640,000
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	60	62	86	60	22,700,000
SOUTH DAKOTA					
Angostura (I)	41	41	69	40	130,770
Belle Fourche (I)	20	20	39	16	185,200
Lake Francis Case (FIP)	54	53	52	53	4,589,000
Lake Oahe (FIP)	55	57	65	54	22,240,000
Lake Sharpe (FIP)	100	101	97	101	1,697,000
Lewis and Clark Lake (FIP)	97	100	101	97	432,000
NEBRASKA					
Lake McConaughy (IP)	51	62	68	48	1,948,000
OKLAHOMA					
Eufaula (FPR)	96	97	91	96	2,378,000
Keystone (FPR)	80	83	96	80	661,000
Tenkiller Ferry (FPR)	102	103	100	103	628,200
Lake Altus (FIMR)	60	73	46	56	133,000
Lake O'The Cherokees (FPR)	89	91	83	90	1,492,000
OKLAHOMA-TEXAS					
Lake Texoma (FMPRW)	96	91	92	96	2,722,000
TEXAS					
Bridgeport (IMW)	89	93	49	88	386,400
Canyon (FMR)	95	88	79	93	385,600
International Amistad (FIMPW)	96	84	86	94	3,497,000
International Falcon (FIMPW)	77	46	75	68	2,668,000
Livingston (IMW)	101	98	87	101	1,788,000
Possum Kingdom (IMPRW)	93	90	96	92	570,200
Red Bluff (P)	21	30	29	20	307,000
Toledo Bend (P)	84	83	81	80	4,472,000
Twin Buttes (FIM)	48	48	33	45	177,800
Lake Kemp (IMW)	92	96	86	90	268,000
Lake Meredith (FMW)	33	40	37	33	796,900
Lake Travis (FIMPRW)	92	63	78	90	1,144,000
MONTANA					
Canyon Ferry (FIMPR)	83	77	87	79	2,043,000
Fort Peck (FPR)	57	62	84	58	18,910,000
Hungry Horse (FIPR)	83	69	82	80	3,451,000
WASHINGTON					
Ross (PR)	92	82	78	92	1,052,000
Franklin D. Roosevelt Lake (IP)	101	94	99	100	5,022,000
Lake Chelan (PR)	97	73	65	83	676,100
Lake Cushman (PR)	52	21	80	38	359,500
Lake Merwin (P)	98	103	91	61	245,600
IDAHO					
Boise River (4 Reservoirs) (FIP)	34	39	51	31	1,235,000
Coeur d'Alene Lake (P)	128	70	53	65	238,500
Pend Oreille Lake (FP)	37	15	46	53	1,561,000
IDAHO-WYOMING					
Upper Snake River (8 Reservoirs) (MP)	36	50	55	27	4,401,000
WYOMING					
Boysen (FIP)	75	81	79	74	802,000
Buffalo Bill (IP)	39	51	70	37	421,300
Keyhole (F)	15	20	41	16	193,800
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	32	35	48	31	3,056,000
COLORADO					
John Martin (FIR)	7	9	16	4	364,400
Taylor Park (IR)	75	72	55	76	106,200
Colorado-Big Thompson Project (I)	48	36	57	48	730,300
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IPPR)	67	76	76	68	31,620,000
UTAH-IDAHO					
Bear Lake (IPR)	33	50	59	33	1,421,000
CALIFORNIA					
Folsom (FIP)	17	34	50	17	1,000,000
Hetch Hetchy (MP)	27	50	43	31	360,400
Isabella (FIR)	8	15	24	8	568,100
Pine Flat (FI)	3	5	39	3	1,001,000
Clair Engle Lake (Lewiston) (P)	39	51	68	42	2,438,000
Lake Almanor (P)	67	71	51	68	1,036,000
Lake Berryessa (FIMW)	37	50	73	38	1,600,000
Millerton Lake (FI)	31	29	39	32	503,200
Shasta Lake (FIPR)	38	48	63	38	4,377,000
CALIFORNIA-NEVADA					
Lake Tahoe (IPR)	0	7	46	0	744,600
NEVADA					
Rye Patch (I)	0	4	50	0	194,300
ARIZONA-NEVADA					
Lake Mead and Lake Mohave (FIMP)	76	81	72	76	27,970,000
ARIZONA					
San Carlos (IP)	5	6	21	5	935,100
Salt and Verde River System (IMPR)	39	49	40	39	2,019,100
NEW MEXICO					
Conchas (FIR)	58	66	82	58	315,700
Elephant Butte and Caballo (FIPR)	59	76	39	59	2,233,300

[1] 1 acre-foot = 0.04356 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second per day.

[2] Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

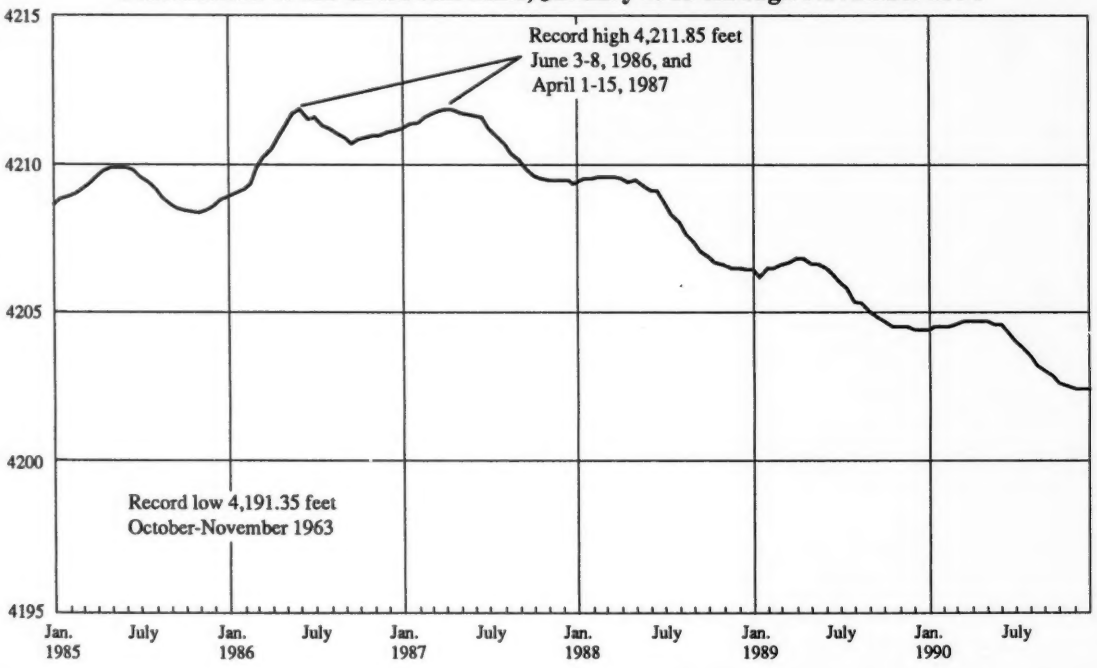
GREAT LAKES ELEVATIONS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period. Data from National Ocean Service.

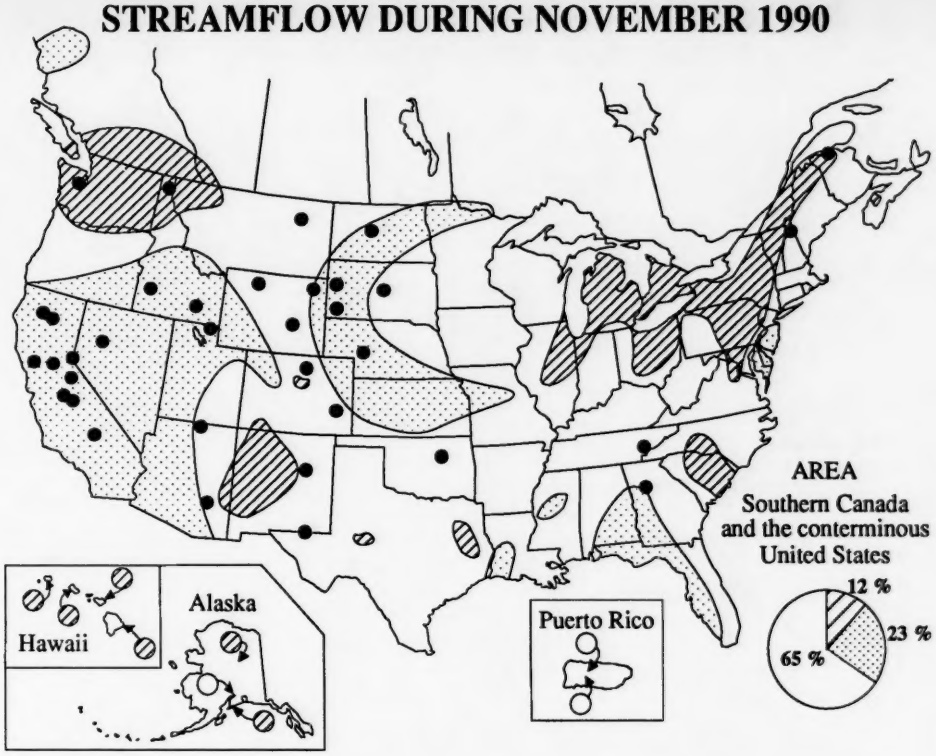


ELEVATION, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929

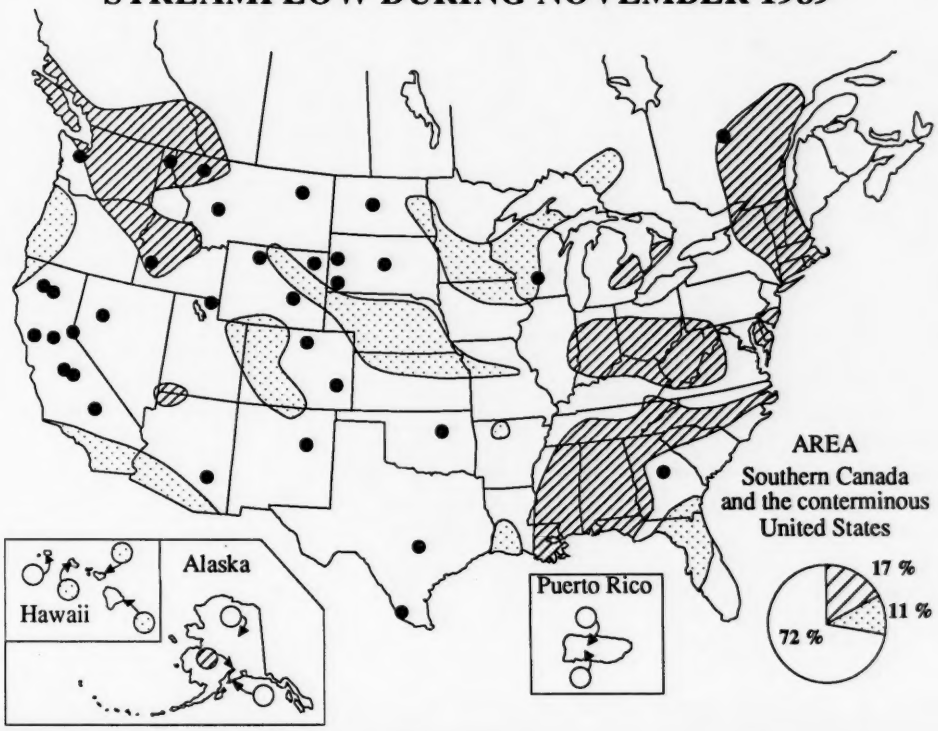
Fluctuations of the Great Salt Lake, January 1985 through November 1990



STREAMFLOW DURING NOVEMBER 1990



STREAMFLOW DURING NOVEMBER 1989

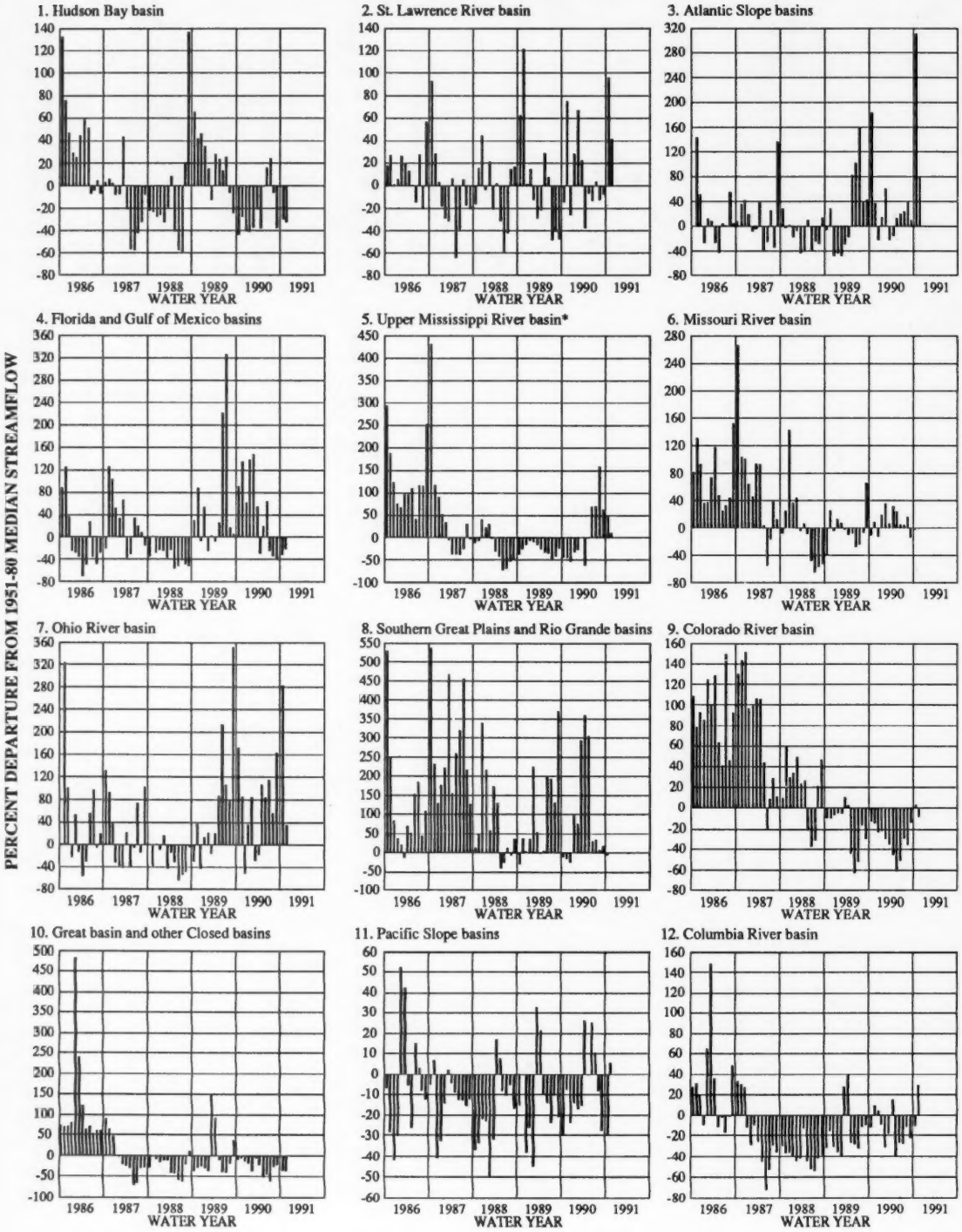


Above-normal range

Below-normal range

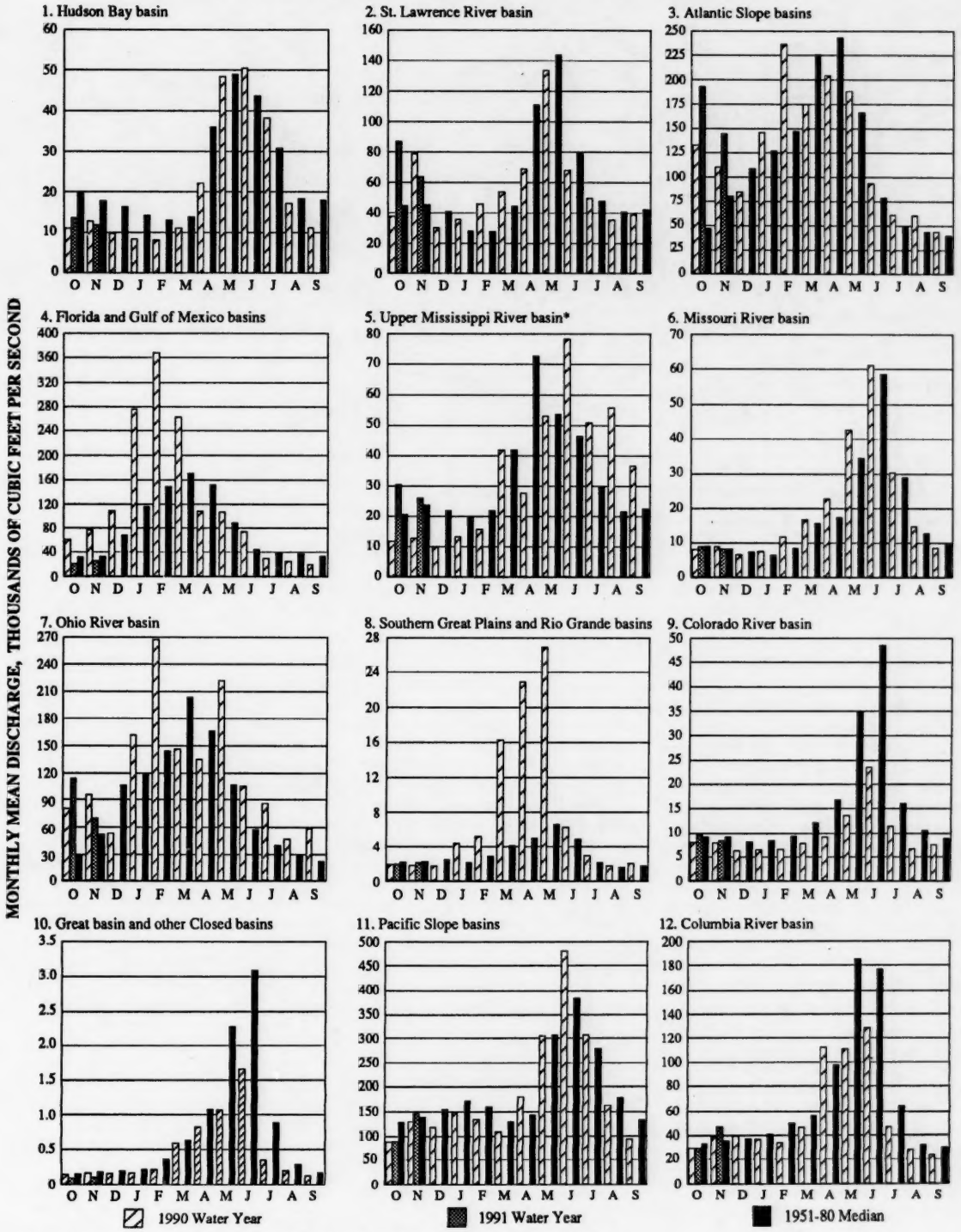
Below-average reservoir storage

MONTHLY DEPARTURE OF ACTUAL STREAMFLOW (OCTOBER 1985-NOVEMBER 1990) FROM MEDIAN STREAMFLOW (1951-80)



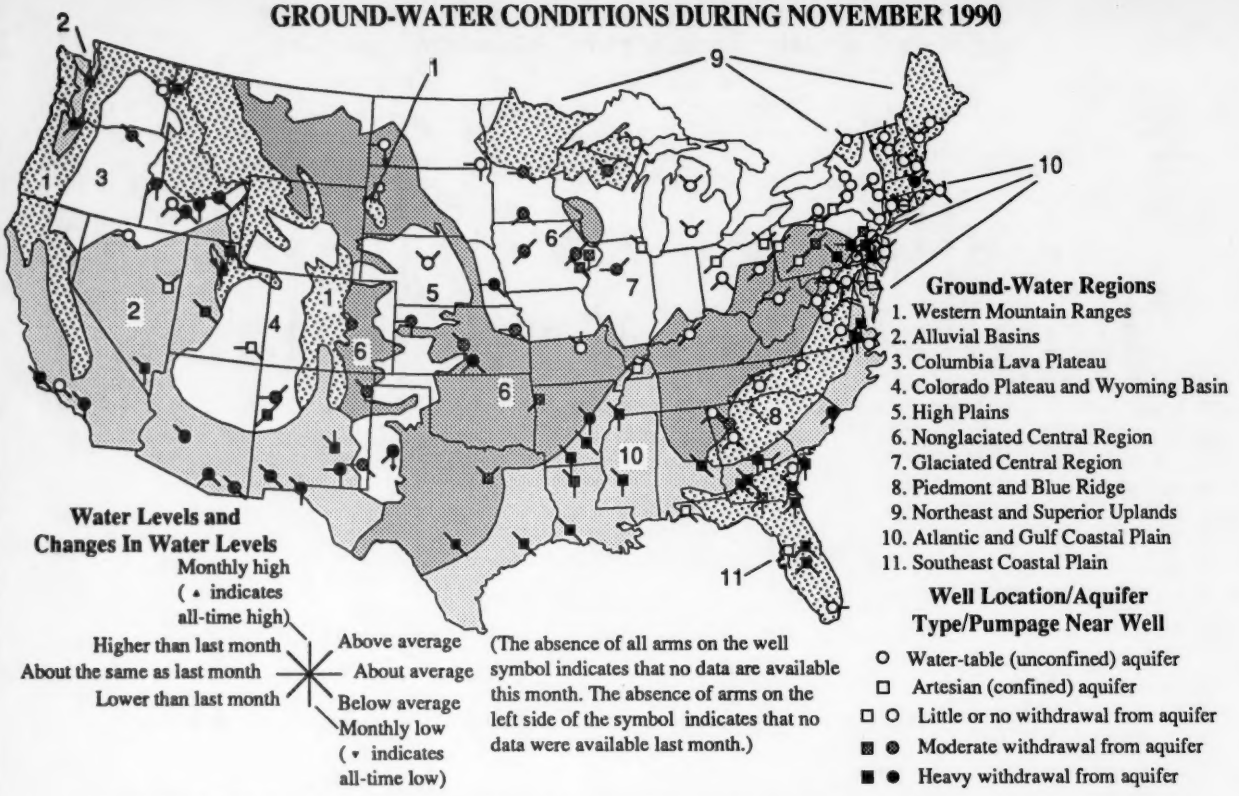
*Revised. Last month's graph inadvertently included data for the Mississippi River at Keokuk, Iowa.

ACTUAL MONTHLY STREAMFLOW, 1990 AND 1991 WATER YEARS, COMPARED WITH MEDIAN MONTHLY STREAMFLOW, 1951-80


1. Hudson Bay basin
2. St. Lawrence River basin
3. Atlantic Slope basins
4. Florida and Gulf of Mexico basins
5. Upper Mississippi River basin*
6. Missouri River basin
7. Ohio River basin
8. Southern Great Plains and Rio Grande basins
9. Colorado River basin
10. Great basin and other Closed basins
11. Pacific Slope basins
12. Columbia River basin
O N D J F M A M J J A S
MONTHLY MEAN DISCHARGE, THOUSANDS OF CUBIC FEET PER SECOND
1990 Water Year
1991 Water Year
1951-80 Median

*Revised. Last month's graph inadvertently included data for the Mississippi River at Keokuk, Iowa.

GROUND-WATER CONDITIONS DURING NOVEMBER 1990


Ground-Water Regions
1. Western Mountain Ranges
2. Alluvial Basins
3. Columbia Lava Plateau
4. Colorado Plateau and Wyoming Basin
5. High Plains
6. Nonglaciated Central Region
7. Glaciated Central Region
8. Piedmont and Blue Ridge
9. Northeast and Superior Uplands
10. Atlantic and Gulf Coastal Plain
11. Southeast Coastal Plain
Well Location/Aquifer Type/Pumpage Near Well
Water-table (unconfined) aquifer
Artesian (confined) aquifer
Little or no withdrawal from aquifer
Moderate withdrawal from aquifer
Heavy withdrawal from aquifer
Water Levels and Changes In Water Levels
Monthly high (▲ indicates all-time high)
Higher than last month
About the same as last month
Lower than last month
Above average
About average
Below average
Monthly low (▼ indicates all-time low)
(The absence of all arms on the well symbol indicates that no data are available this month. The absence of arms on the left side of the symbol indicates that no data were available last month.)

Ground-water levels in the two wells for the Western Mountain Ranges rose to above average levels in November.

In the Alluvial Basins, levels rose above last month's levels except in Oregon and part of Arizona where they fell. Nevertheless, levels remained below average in most of the Region except in Washington and Oregon. Record lows occurred in wells in the: Alluvial sand and gravel aquifer at Baldwin Park, California (58 years of record); Alluvial aquifer at Las Vegas Valley, Nevada (44 years of record); Basin fill aquifer at Holladay, Utah (61 years of record); Roswell Basin shallow aquifer at Dayton, New Mexico (39 years of record); and Hueco Bolson aquifer at El Paso, Texas (25 years of record). Level rose to a new high in the Roswell Basin artesian aquifer well at Roswell, New Mexico (24 years of record).

Water levels in the Columbia Lava Plateau were mixed with respect to last month's levels, but remained below long-term averages. Despite a rise in level since last month, a new November low occurred in the Snake River Plain aquifer well at Rupert, Idaho (40 years of record). Level fell to a low equal to the record set in 1935 in the Shallow alluvium aquifer at Meridian, Idaho (56 years of record).

In the Colorado Plateau and Wyoming Basin, ground-water levels remained the same or were below last month's levels. Water levels remained below average in Utah and above average in New Mexico.

In the High Plains Region, water levels were mixed with respect to last month's. Levels remained below long-term averages, except in Nebraska where they were above average. A new November low occurred in the Ogallala aquifer well at the Agricultural Experiment Station at Colby, Kansas (43 years of record) and an all-time low occurred in the Ogallala aquifer well at Lubbock, Texas (39 years of record).

Water levels in the Non-glaciated Central Region fell from last month's levels in South Dakota, Arkansas, Kentucky, Georgia, and parts of Kansas, Pennsylvania, and Maryland. Elsewhere, levels remained the same or rose. Levels were below long-term averages in the Dakotas, Kansas, part of Maryland, and Georgia; mixed in Pennsylvania; and above average in Missouri, Kentucky, West Virginia, and Virginia. November highs occurred in the Ozark aquifer well at Rolla, Missouri (2 years of record), and in the Bellefonte Formation well at Roseann, Pennsylvania (7 years of record). Monthly lows occurred in the Minnelusa aquifer well near Tilford, South Dakota (6 years of record), and in the Equus Beds aquifer well at Halstead, Kansas (50 years of record). An all-time low occurred in the Sentinel Butte aquifer well at Dickinson, North Dakota (32 years of record).

In the Glaciated Central Region, levels were above last month's, and also above long-term averages in Illinois and Michigan. Levels were below both last month's levels and average in Minnesota and New Jersey. In Pennsylvania, levels were below last month's, but mixed with respect to average. Elsewhere levels were mixed with respect to both last month's levels and average. Record lows occurred in the Sheyenne Delta aquifer well at Wyndmere, North Dakota (27 years of record), and in the Cambrian-Ordovician aquifer at Mount Vernon, Iowa (3 years of record).

Water levels were mixed with respect to last month in the Piedmont and Blue Ridge. Levels were at or above long-term averages in Virginia and North Carolina and below average in Pennsylvania and Georgia. Despite a decline in water level, a November high occurred in the Weathered granite aquifer well at Mocksville, North Carolina (9 years of record).

In the Northeast and Superior Uplands, water levels rose in Wisconsin, Michigan, New Hampshire, Massachusetts and New York, and were mixed elsewhere with respect to last month. Levels were below long-term averages in Minnesota and Michigan, but at or above average elsewhere. Record highs occurred in the Bedrock aquifer well at Hookset, New Hampshire (25 years of record) and in the Pleistocene sand aquifer well at Morrisville, Vermont (24 years of record).

In the Atlantic and Gulf Coastal Plain, levels declined from last month in Delaware, Virginia, South Carolina, Florida, and Kentucky, and rose in North Carolina, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, and Texas. Elsewhere levels were mixed with respect to last month. Water levels were generally below average, except in New Jersey where they were

Provisional data; subject to revision

WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES–NOVEMBER 1990

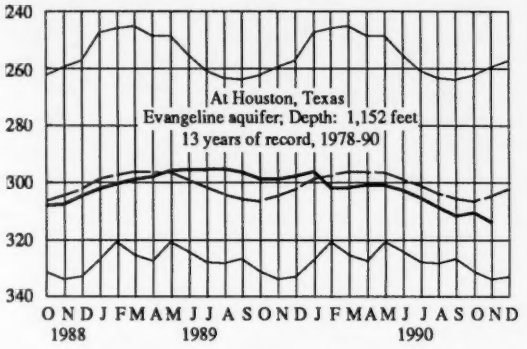
GROUND–WATER REGION Aquifer and Location	Aquifer type and local aquifer pumpage	Depth of well in feet	Water level in feet below land–surface datum	Departure from average in feet	Net change in water level in feet since: Last month	Net change in water level in feet since: Last year	Year records began	Remarks
WESTERN MOUNTAIN RANGES (1)								
Rathdrum Prairie aquifer, Athol, northern Idaho	●	480	459.6	1.1	1.1	5.9	1929	
ALLUVIAL BASINS (2)								
Alluvial valley fill aquifer in Steptoe Valley, Nevada	□	122	8.38	4.07	.31	–.71	1950	
Alluvial sand and gravel aquifer, Baldwin Park, California	●	200	186.06	–64.37	1.01	–8.85	1932	Nov. low
Valley fill aquifer, Elfrida area, Douglas, Arizona	◍	124	99.69	–16.85	1.55	–.11	1951	
Hueco bolson aquifer, El Paso area, Texas	●	640	271.85	–21.32	.83	–1.10	1965	Nov. low
COLUMBIA LAVA PLATEAU (3)								
Snake River Plain aquifer, at Eden, Idaho	●	208	121.7	–5.2	–3.3	–1.6	1957	
Columbia River Basalt aquifer, Pendleton, Oregon	◍	1,501	218.40	–27.38	1.40	–3.16	1965	
COLORADO PLATEAU AND WYOMING BASIN (4)								
Dakota aquifer, Blanding, Utah	□	140	46.34	–.40	–.03	–5.86	1960	
HIGH PLAINS (5)								
Wind–blown sand deposits of the High Plains Aquifer System, Dunning, Nebraska	○	13	3.71	.36	.49	.38	1934	
Southern High Plains aquifer, Lovington, New Mexico	◍	212	59.89	–4.51	.09	–.02	1971	
NON–GLACIATED CENTRAL REGION (6)								
Sentinel Butte aquifer, Dickinson, North Dakota	○	160	21.00	–2.63	–.01	–1.18	1968	All–time low
Sand and gravel Pleistocene aquifer, Valley Center, Kansas	●	54	20.07	–2.77	–.14	.97	1937	
Glacial outwash sand and gravel aquifer, Louisville, Kentucky	◍	94	18.07	6.71	–.19	.94	1945	
Upper Pennsylvanian aquifer in the Central Applachian Plateau, Glenville, West Virginia	○	25	15.57	2.08	–.08	–.78	1954	
GLACIATED CENTRAL REGION (7)								
Fluvial sand and gravel aquifer, Platte River Valley, Ashland, Nebraska	●	12	7.66	–1.41	.04	–.69	1933	
Sheyenne Delta aquifer, Wyndmere, North Dakota	○	40	8.68	–2.81	–.03	–.26	1963	Nov. low
Pleistocene (glacial drift) aquifer, at Princeton in northern Illinois	◍	29	6.60	6.03	–.02	.65	1942	
Shallow drift aquifer at Roscommon in north–central part of Lower Peninsula, Michigan.	○	14	4.61	.25	.25	.94	1934	
Silurian–Devonian carbonate aquifer near Dola, Ohio	□	51	6.84	2.89	–.72	2.32	1954	
PIEDMONT AND BLUE RIDGE (8)								
Water–table aquifer in Petersburg Granite, southeastern Piedmont, Colonial Heights, Virginia.	○	100	16.24	.08	–.37	–1.39	1939	
Weathered granite aquifer, western Piedmont, Mocksville area, North Carolina.	○	31	16.03	4.64	–.38	.38	1981	Nov. high
Surficial aquifer at Griffin, Georgia	○	30	21.34	–3.41	–.50	–2.44	1943	
NORTHEAST AND SUPERIOR UPLANDS (9)								
Pleistocene glacial outwash aquifer, Camp Ripley, Minnesota	◍	59	14.64	–1.7	–.06	.67	1949	
Glacial till aquifer at Augusta, Maine	○	22	4.70	–.08	–.52	.81	1960	
Shallow sand aquifer (glacial deposits), Acton, Massachusetts	●	34	18.99	.86	.75	–.45	1965	
Pleistocene sand aquifer, Morrisville, Vermont	○	50	17.75	1.58	–1.60	1.12	1966	
ATLANTIC AND GULF COASTAL PLAIN (10)								
Columbia deposits aquifer, Camden, Delaware	□	11	9.00	–1.47	–1.52	–4.03	1950	
500–foot sand aquifer near Memphis, Tennessee	■	384	107.84	–16.85	.49	–.24	1940	Nov. low
Eutaw aquifer in the City of Montgomery, Alabama	■	270	27.1	–3.6	.4	–.5	1952	
Evangeline aquifer, Houston area, Texas	■	1,152	313.83	–8.98	3.28	–14.76	1978	
SOUTHEAST COASTAL PLAIN (11)								
Upper Floridan aquifer on Cockspur Island, Savannah area, Georgia	■	348	38.10	–10.02	.73	–1.69	1956	Nov. low
Upper Floridan aquifer, Jacksonville, Florida	■	905	–19.6	–8.9	–.4	–1.6	1930	Nov. low
Biscayne aquifer, Homestead, Florida	○	20	7.07	–.10	.35	–.20	1932	

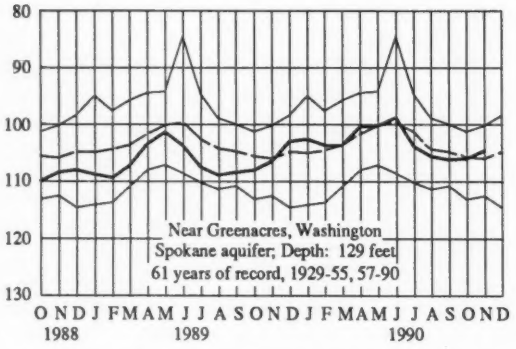
mixed, and in North Carolina and Kentucky where they were above average. Record lows occurred in the Middle Potomac aquifer well at Franklin (30 years of record) and in the Upper Potomac aquifer well at Toano (5 years of record), Virginia; Dublin aquifer well at Taversville, Georgia (15 years of record); Sparta Aquifer System well at Jackson, Mississippi (46 years of record); 500-foot sand aquifer well at Memphis, Tennessee (49 years of record); Sparta Sand aquifer well at El Dorado (35 years of record) and Mississippi Valley alluvial aquifer at Lonoke (15 years of record), Arkansas; and Sparta Sand aquifer well at Ruston, Louisiana (16 years of record). Level fell to an all-time low in the Pee Dee aquifer well at Collins Park, South Carolina (16 years of record).

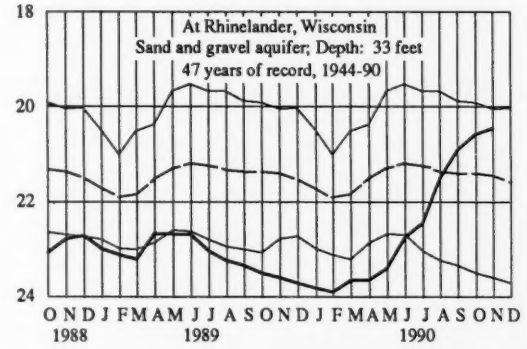
Water levels were mixed with respect to last month's in the Southeastern Coastal Plain and were generally below long-term averages. Record lows occurred in Upper Floridan aquifer wells at Valdosta (33 years of record) and on Cockspur Island (34 years of record), Georgia, and also in Jacksonville (47 years of record) and San Antonio (26 years of record), Florida.

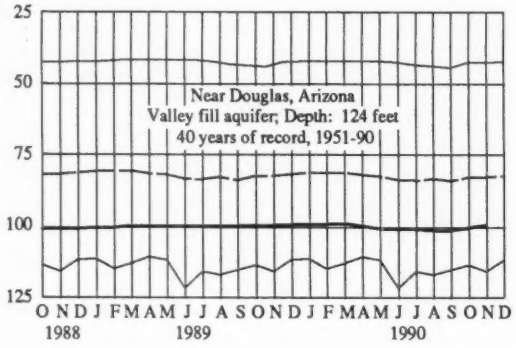
MONTHEND GROUND-WATER LEVELS IN SELECTED WELLS

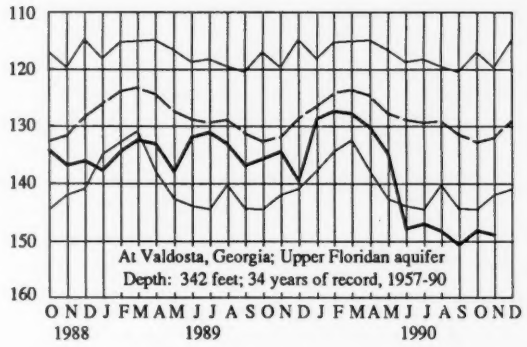
Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates average of monthly levels in previous years. Heavy line indicates level for current period.

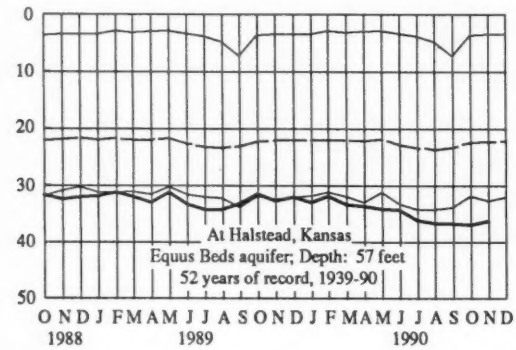


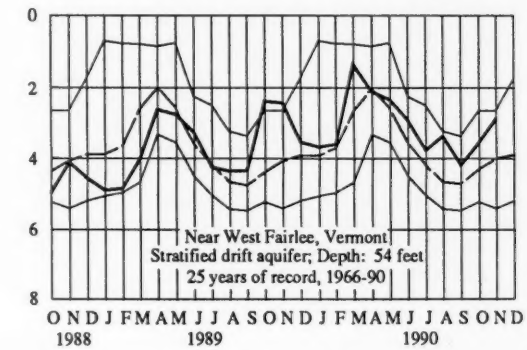



At Rhinelander, Wisconsin
Sand and gravel aquifer; Depth: 33 feet
47 years of record, 1944-90
18
20
22
24
O N D J F M A M J J A S O N D J F M A M J J A S O N D
1988
1989
1990


Near Douglas, Arizona
Valley fill aquifer; Depth: 124 feet
40 years of record, 1951-90
25
50
75
100
125
O N D J F M A M J J A S O N D J F M A M J J A S O N D
1988
1989
1990

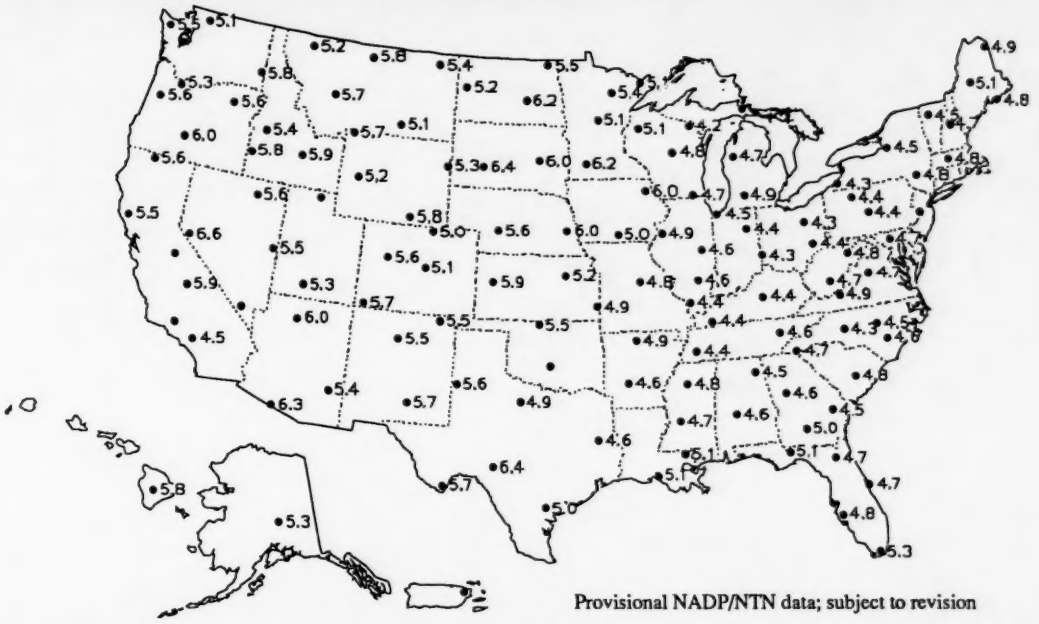

At Valdosta, Georgia; Upper Floridan aquifer
Depth: 342 feet; 34 years of record, 1957-90
110
120
130
140
150
160
O N D J F M A M J J A S O N D J F M A M J J A S O N D
1988
1989
1990




Near West Fairlee, Vermont
Stratified drift aquifer; Depth: 54 feet
25 years of record, 1966-90
0
2
4
6
8
O N D J F M A M J J A S O N D J F M A M J J A S O N D
1988
1989
1990

WATER LEVEL, FEET BELOW LAND-SURFACE DATUM

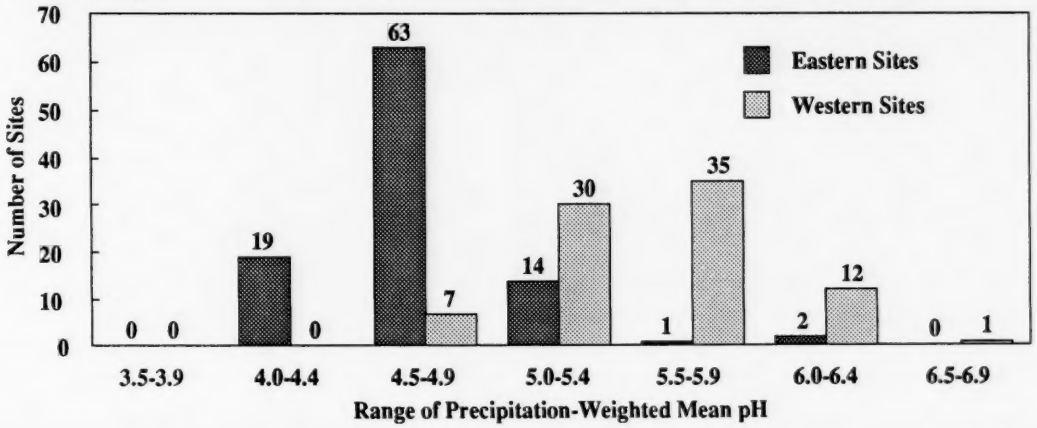
pH of Precipitation for October 22 - November 25, 1990

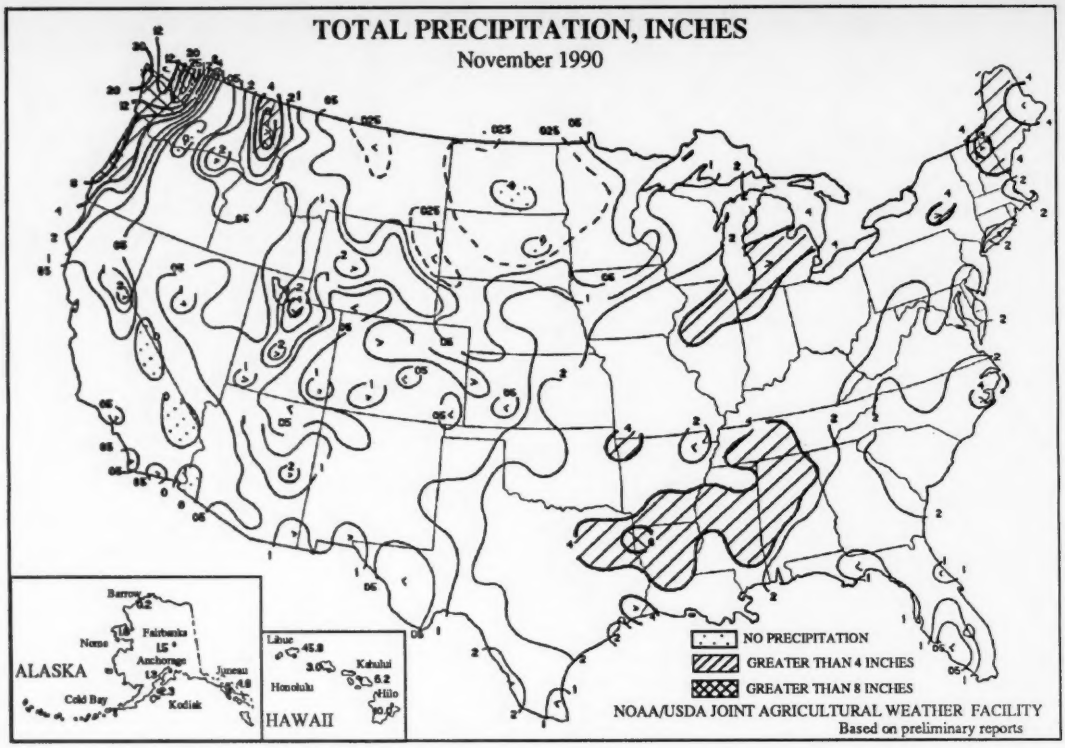


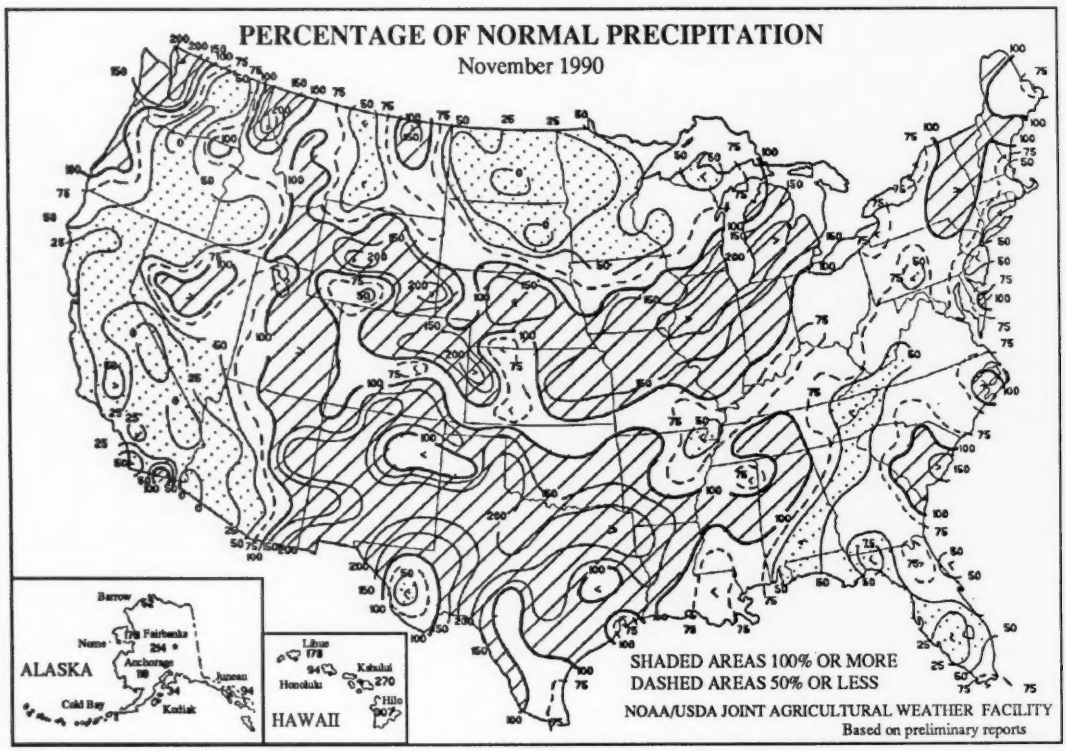
Current pH data shown on the map (• 4.9) are precipitation-weighted means calculated from preliminary laboratory results provided by the NADP/NTN Central Analytical Laboratory at the Illinois State Water Survey and are subject to change. The 127 points (•) shown on this map represent a subset of all sites chosen to provide relatively even geographic spacing. Absence of a pH value at a site indicates either that there was no precipitation or that data for the site did not meet preliminary screening criteria for this provisional report.

A list of the approximately 200 sites comprising the total Network and additional data for the sites are available from the NADP/NTN Coordination Office, Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523.

Distribution of precipitation-weighted mean pH for all NADP/NTN sites having one or more weekly samples for October 22 - November 25, 1990. The East/West dividing line is at the western borders of Minnesota, Iowa, Missouri, Arkansas, and Louisiana. Numbers above each column represent the total number of sites in the interval.





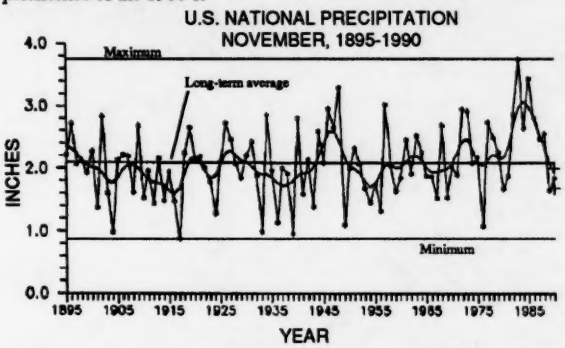


(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

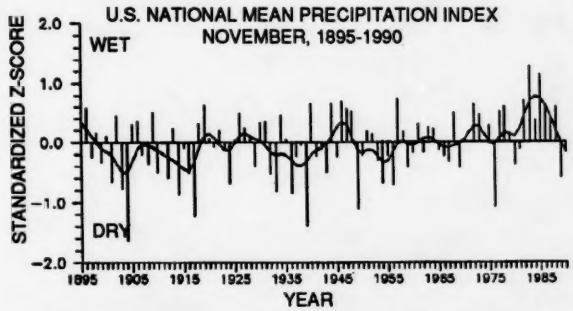
UNITED STATES NOVEMBER CLIMATE IN HISTORICAL PERSPECTIVE

(From Climate Perspectives Branch, Global Climate Lab, NCDC, NOAA)

Preliminary data for November 1990 indicate that temperature averaged across the contiguous United States was much above the long-term mean. November 1990 ranked as the sixth warmest November on record (the record begins in 1895). The 1990 value is based on preliminary data, which has been shown to be within 0.25° F of the final data over a 22-month period. Novembers during the last four years have been consistently warmer than average. This is comparable to the warm November persistence of the 1960's.

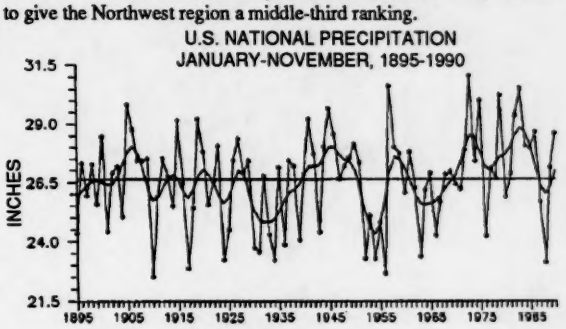


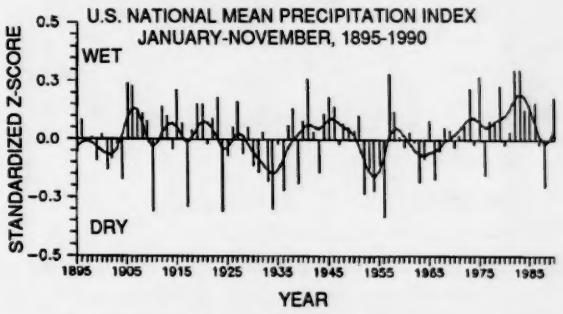
Areally-averaged precipitation for the nation was slightly below the long-term mean, ranking November 1990 as the 28th driest November on record. The preliminary value for precipitation is estimated to be accurate to within 0.16 inches and the confidence interval is plotted in the graph above as a '+'.



Historical precipitation is shown in a different way above. The November precipitation for each climate division in the contiguous U.S. was first standardized using the gamma distribution over the 1951-80 period. These gamma-standardized values were then weighted by area and averaged to determine a national standardized precipitation value. Negative values are dry, positive are wetter than the mean. This index gives a more accurate indication of how precipitation across the country compares to the local normal climate. The areally-weighted mean standardized national precipitation ranks November 1990 as the 37th driest November on record. The filtered curves in both graphs suggest that the Novembers of the last two years have interrupted a pattern of unusually wet Novembers that persisted throughout much of the 1980's. The filtered curves also suggest that Novembers have generally been getting wetter during the last 90 years.

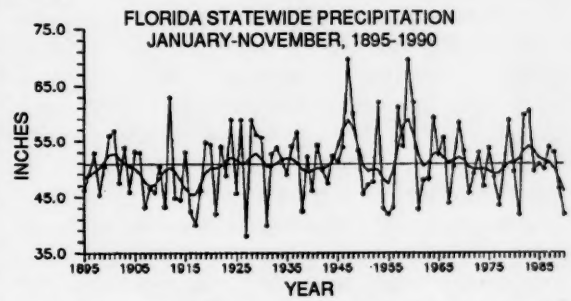
Temperature and precipitation rankings for November 1990 for the nine climatically homogeneous regions in the United States indicate that, in general, most of the country averaged in the warm third of the historical distribution, while temperatures were in the middle third of the distribution in the West region. According to National Weather Service records, over 350 daily record high temperatures were reported during the month. Precipitation averaged near the middle of the distribution except for the West, Southeast, and West North Central regions, which were on the dry side. The unusually wet conditions along the Washington coast were counterbalanced by drier than normal conditions inland to give the Northwest region a middle-third ranking.



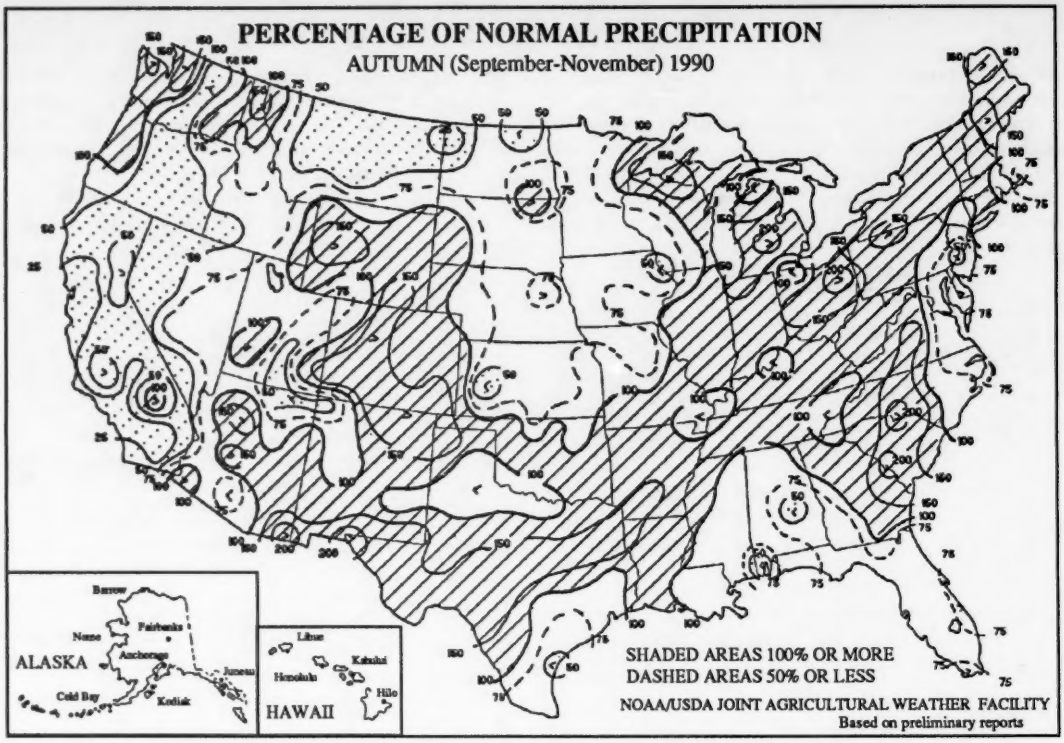


The year so far, for the nation as a whole, has been unusually warm, with January-November 1990 ranking as the third warmest January-November period on record. January-November 1990 ranked as the 14th wettest such period when precipitation is examined, and eleventh wettest such period when the standardized precipitation index is examined.

January-November precipitation and temperature rankings for the lower 48 states indicate that 14 states have had the tenth wettest, or wetter, January to November period on record in 1990, with only one state (Florida) ranking in the top 10 driest category. More than two-thirds of the lower 48 states (34) have had the tenth warmest, or warmer, January to November period on record in 1990, with four east coast states (Delaware, Florida, and the Carolinas) having the warmest on record.



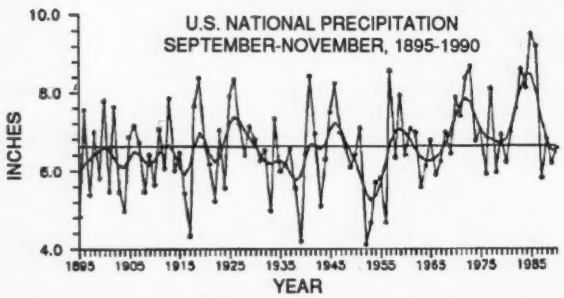
In Florida, 1990 marks the second consecutive year with below-normal January-November precipitation. While conditions this year have been very dry, consecutive very dry years have occurred several times in the past.



(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

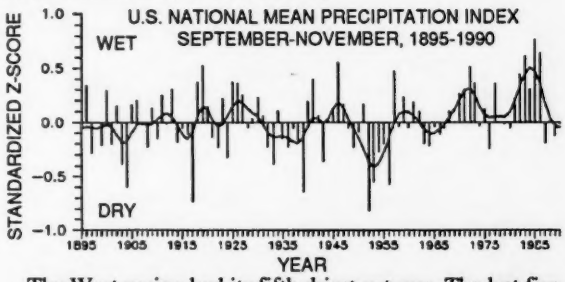
UNITED STATES AUTUMN CLIMATE IN HISTORICAL PERSPECTIVE

(From Climate Perspectives Branch, Global Climate Lab, NCDC, NOAA)

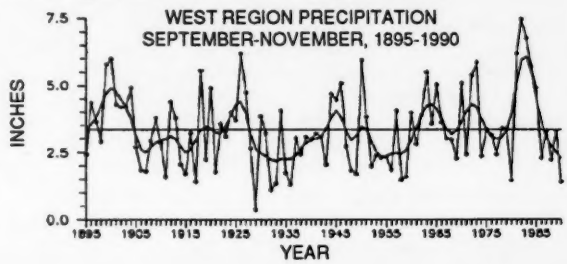


Preliminary data for Autumn (September-November) 1990 indicate that areally-averaged precipitation for the nation was near the long-term mean. The last four years have seen a departure from the extremely wet autumns of the mid-1980's. The filtered curve hints at a periodicity overlying an increasing trend in the autumn precipitation, especially in the last 30 years.

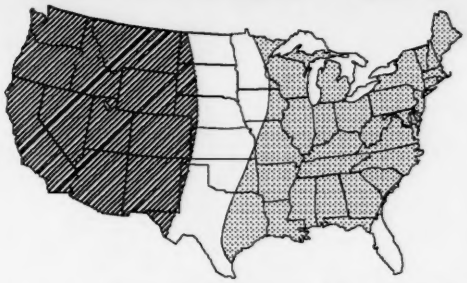
Historical autumn precipitation is shown in another way using gamma-standardized values weighted by area, then averaged to determine a national standardized precipitation value. Negative values are dry, positive are wetter than the mean. This index gives a more accurate indication of how precipitation across the country compares to the local normal climate.



The West region had its fifth driest autumn. The last five autumns have been near or below the long-term mean, which contrasts sharply with the record wetness of the early 1980's. However, the historical record reveals other periods with persistently dry autumns, so while the recent autumn dryness in the region is unusual, it is not unprecedented.



TEMPERATURE OUTLOOK FOR DECEMBER 1990-FEBRUARY 1991



PRECIPITATION OUTLOOK FOR DECEMBER 1990-FEBRUARY 1991

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NATIONAL WATER CONDITIONS

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EXPLANATION OF DATA (Revised December 1990)

Cover map shows generalized pattern of streamflow for the month based on provisional data from 186 index gaging stations—18 in Canada, 166 in the United States, and 2 in the Commonwealth of Puerto Rico. Alaska, Hawaii, and Puerto Rico inset maps show streamflow only at the index gaging stations that are located near the point shown by the arrows. Classifications on map are based on comparison of streamflow for the current month at each index station with the flow for the same month in the 30-year reference period, 1951-80. Shorter reference periods are used for one Canadian index station, two Kansas index stations, and the Puerto Rico index stations because of the limited records available.

The ***streamflow ranges map*** shows where streamflow has persisted in the above- or below-normal range from last month to this month and also where streamflow is in the above- or below-normal range this month after being in a different range last month. Three ***pie charts*** show: the percent of stations reporting discharges in each flow range for both the conterminous United States and southern Canada, and also the percent of area in each flow range for the conterminous United States and southern Canada. The ***combination bar/line graph*** shows the percent departure of the total mean from the total median flow (1951-80) and the cumulative departure from median (in cfs) for all reporting stations (excluding eight large river stations indicated by * in the ***Flow of large rivers*** table) in the conterminous United States and southern Canada.

The comparative data are obtained by ranking the 30 flows for each month of the reference period in order of decreasing magnitude—the highest flow is given a ranking of 1 and the lowest flow is given a ranking of 30. Quartiles (25-percent points) are computed by averaging the 7th and 8th highest flows (upper quartile), 15th and 16th highest flows (middle quartile and median), and the 23rd and 24th highest flows (lower quartile). The upper and lower quartiles set off the highest and lowest 25 percent of flows, respectively, for the reference period. The median (middle quartile) is the middle value by definition. For the reference period, 50 percent of the flows are greater than the median, 50 percent are less than the median, 50 percent are between the upper and lower quartiles (in the normal range), 25 percent are greater than the upper quartile (above normal), and 25 percent are less than the lower quartile (below normal). Flow for the current month is then classified as: in the ***above-normal range*** if it is greater than the upper quartile, in the ***normal range*** if it is between the upper and lower quartiles, and in the ***below-normal range*** if it is less than the lower quartile. Change in flow from the previous month to the current month is classified as ***seasonal*** if the change is in the same direction as the change in the median. If the change is in the opposite direction of the change in the median, the change is classified as ***contraseasonal*** (opposite to the seasonal change). For example: at a particular index station, the January median is greater than the December median; if flow for the current January increased from December (the previous month), the increase is seasonal; if flow for the current January decreased from December, the decrease is contraseasonal.

Flood frequency analyses define the relation of flood peak magnitude to probability of occurrence or recurrence interval. ***Probability of occurrence*** is the chance that a given flood magnitude will be exceeded in any one year. ***Recurrence interval*** is the reciprocal of probability of occurrence and is the average number of years between occurrences. For example, a flood having a probability of occurrence of 0.01 (1 percent) has a recurrence interval of 100 years. ***Recurrence intervals imply no regularity of occurrence***; a 100-year flood might be exceeded in consecutive years or it might not be exceeded in a 100-year period.

Statements about ***ground-water levels*** refer to conditions near the end of the month. The water level in each observation well is compared with average level for the end of the month determined from the entire period of record for that well. ***Changes in ground-water levels***, unless described otherwise, are from the end of the previous month to the end of the current month.

Dissolved solids and temperature data are given for five stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). ***Dissolved solids*** are minerals dissolved in water and usually consist predominately of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. ***Dissolved-solids discharge*** represents the total daily amount of dissolved minerals carried by the stream. ***Dissolved-solids concentrations*** are generally higher during periods of low streamflow, but the highest dissolved-solids discharges occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

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